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THE EVOLUTION OF COLONIES.

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I.—THE GENESIS OF COLONIES.

NOWHERE is the analogy between the individual and the society more applicable than at the beginnings of both. Though, as research advances, it will probably be found instructive at the very summit of the scale,* it is most illuminative at the base, where the individual and social organisms are often indistinguishable. It is then perceived to be an identity which binds together two widely separated provinces of knowledge. So close is the parallelism in the lower ranges that biological statements have only to be translated into sociological terms. The genesis of individuals is the key to the genesis of societies, and of those special societies named colonies. The biology of reproduction is the foundation of what may be styled coloniology.

Reproduction in its earliest or sexless form is discontinuous growth. Species can be arranged in an ascending series so as to exhibit an insensible transition from mere expansion of the parent mass to the budding off of new individuals. In certain species, like the sponge, the two processes are identical, and no true line of division can be drawn.

Colonization is the national mode of self-reproduction, and here again extension and multiplication are inseparable. Continuous population, remarks Grote, was not the law of the ancient world. A Greek city-state did not grow by expansion, as a modern state does; it grew only by multiplication. It did not annex adjacent

* See a recent treatise: Conscience et volonté sociales. By J. Novicow. Paris, 1896.

territory; it planted a colony. The coast of Asia Minor was colonized from the Greek mainland and the islands of the archipelago; the whole country would nowadays be annexed by a conquering power as the spoil of a single battle and permanently occupied; but it was successively settled by twelve Ionic and twelve Æolic colonies, each of them independent, with conterminous territories. A Greek colony grew in the same way. Naxos or Syracuse, on the Sicilian coast, might, either of them, have annexed the strip of territory between them; they colonized it. A Greek city, like a hydra, was incapable of expanding beyond a certain point; when that point was reached the mass broke and gave birth to a new city. Greece seems never to have got beyond the city stage of national development. Roman colonies were at first of the same character. They were planted in conquered territory, to hold it for Rome, and had a certain independence; as the intervening space between Rome and the colony was occupied by Roman citizens, the colony became continuous with the city and formed part of an undivided empire. So does every nation advance over its own territory. Each new clearing in the surrounding forest is the seat of a colony. The trapper and fur trader of the early days in North America were continually founding stations ever farther in the interior, which proved the nuclei of fresh settlement. The pioneer squatter of Australia is still moving into untrodden regions. Such colonies are like grasses, which are sown by the wind in a myriad separate plants, but become contiguous and form the carpeted turf. As reproduction is discontinuous growth, colonization is discontinuous expansion.

Growth is everywhere limited by the constitution of the organism; beyond a certain size the mass of cells can not be governed from a common center. The limit attained, the augmentation takes on the form and structure of the parent, and, thinning away at the point of junction, a new individual is launched into space. This is the form of reproduction proper to the lower half of organic creation—to invertebrate animals and the more lowly forms of plants. It is nonsexual, for it is produced neither by sexual individuals nor by separate sexual organs in the same individual, nor by the union of differentiated cells. It takes place in unicellular organisms, like the protozoa, by the rupture of the unit mass of protoplasm. Higher species, like sponges or hydras, protrude buds at any point or all round, which often remain connected with the parent. Or there may be an outflow at a single point successively repeated. The bud may be of all sizes, but is usually less than the parent; in rare cases it is equally large.

The earliest forms of colonization answer in all respects to asexual reproduction. The Phœnician and Greek cities were units;

they were social protozoa. When colonization took place, the city split "by natural fracture" (the words are Grote's) into two or more cities, each an autonomous and separate unit, as Phocæa sent nearly one half of its citizens to Sardinia. Or a city gave birth to a number of cities, as Andros (itself a colony of Eretria) to Samê, Akanthus, Stageira, and Argilus. Sometimes even Greek and Phœnician colonies (celebrated for their independence) remained connected with the mother city, as when Sybaris ruled over twenty-five dependent towns, and Carthage welded three hundred communities into her wide commercial empire. Often the reproduction was concentrated into a single extrusion or overflow, as when Thera colonized Cyrene. Most of the colonies were smaller than the metropolis, but Sybaris and Carthage must have greatly exceeded the parent states.

The Roman colonies were of higher structure. They may be described as midway between the city type of colony and the national type. The earliest were hived off from the mother city and acquired some of the civic character that she retained all through her history till she was nationalized in 1870. They may be compared, like certain of the Greek colonial groups, to the progeny that surrounds a zoöphyte and remains in asexual continuity with it; but, though they long retained a certain independence, they showed that they belonged to a higher type by being ultimately incorporated with the Roman Empire.

The earliest modern colonies, with a still higher potentiality of future development, had the same asexual character as the earliest Phœnician, Greek, and Roman colonies. They were the spontaneous offshoots of the mother country, and they were of low organization. The whole asexual or unorganized division may be classified in five or six groups.

The pioneers of colonization were pirates and marauders, fishermen and navigators, hunters and traders, explorers and discoverers, missionaries, runaways, adventurers, and convicts. It would be impossible to make a tripos of these very miscellaneous groups, or arrange them in the order of time or importance. As the exterior cells of a floating organism push outward at one or more points in search of food, many, perhaps most, colonies have their beginnings in the spontaneous efforts of independent sections of a community, situated on or near its boundaries, which extend to ever more distant parts their exertions in search of a livelihood. It is easier to rob others than to procure spoil or food where they found or reared it, and so privateers and marauding adventurers may have preceded fishermen and hunters. The earliest Greek and Roman colonies seem to have been founded by just such bands. The Spanish and

Portuguese colonies of South America were hardly more exalted in their origin. The Dutch East Indies were colonized by a band of landless resolutes from the Texel—disorderly youths (says the old chronicler), "whose absence was more desired" there "than their presence." The gentlemen adventurers who founded Acadia, like the two La Tours, the renegade Frenchmen (like De Castin and his half-breed son) and the forest rangers who "blazed the track" in Canada for future settlers, Kipling's "gentlemen rovers" and "lost legion," Mr. Cecil Rhodes himself, when he seized Matabeleland, are types of this class. The Jamieson raid was only the last of the daring burglaries by which ancient and modern colonial empires have been built up.*

The toilers who reap the harvest of the sea, half savage as they have always been and often still are, have at least more honest ways. It was mariners from Biscay, and Guipuzcoa, in the beginning of the fourteenth century, who sailed down the African coast as far as the Canaries and led the modern colonizing movement. Basque, Breton, and Norman fishermen were the first authentic visitors to the New World, and they were soon followed by fishermen from the west of England. They did not at first settle. Like the whalers and the Labrador fishermen of to-day, they went home as soon as they had filled their barks, returning each successive season. Their next step was to establish headquarters, as the Newfoundland fishermen at St. John's. Finally, they came for good, as did the English fishermen who settled on the Plymouth coast. Newfoundland may be described as the fishing colony *par excellence*. Few of the ancient colonies had a similar origin, but the five Greek colonies in the Gulf of Tarentum, together with Cumæ and famous Byzantium, may partly have so begun.

The establishment of commercial relations with indigenous peoples has been at the foundation of a much larger number of colonies. Commerce possibly arose out of fishing. As may still be observed on any seacoast, fishing vessels were converted into merchant ships and fishermen differentiated into seamen, some of whom were specialized into merchants. The first ships were also shops. The poet of the Odyssey describes a Phœnician ship as lying for a whole year off a port in the Grecian archipelago, engaged in constant traffic with the natives, and only departing when she had sold her entire cargo and taken a fresh one on board. Cutters laden with cheap drapery still coast along thinly populated countries, running up rivers and creeks and disposing of their merchandise to visitors conveyed to

* It is no longer the last. The Power that most vigorously protested against the raid—Carlyle's "pious Germany"—has herself, with a mixture of sanctimony and effrontery, laid violent hands on the territory of an unoffending people.

them in boats. The next step was to establish a warehouse on shore. In the early days of Australia sea captains brought out adventure cargoes, and on the second or third trip they landed their merchandise and sold it in shops which they built or hired. Just in this way we imagine the bold navigators of Phœnicia and Carthage to have traversed the Mediterranean, and, carrying their own wares to distant parts, received in exchange the products of foreign countries. As the trade grew, they left agents in charge of their warehouses who became the nucleus of a colony, as to-day Greeks or Germans settle in Liverpool or Adelaide and form a quasi-colony. The coasts of Sicily, Italy, and Greece, Africa and Spain, Gaul and Britain were thus dotted with commercial establishments, The Tyrian settlements are said not to have advanced beyond the stage of factories; yet Cadiz, the oldest city in western Europe, is of Tyrian foundation. The Carthaginians aimed at conquest as well as trade, welded some three hundred communities into an empire, maintained an army in Iberia, and fought for supremacy with the future mistress of the world. Yet neither were their settlements always colonies, and when the Greeks threatened to supplant them in Sicily they abandoned their outposts and concentrated themselves in a few principal points. The colonies of the most intellectual nation in the world were, nine tenths of them, commercial in their origin; the ancient Greeks were "a nation of shopkeepers." They unscrupulously seized an island adjoining the mainland, an isthmus or headland that could be easily fortified and defended, and there established a seaport, commanding a monopoly of trade with the natives. The Ionian settlements on the coast of Asia Minor answered to this description, and most of them had this origin. The coasts of Thrace, the Propontis, and the Black Sea were dotted with such merchant colonies. Calabria and Sicily were almost Hellenized. In far-away Marseilles and at the mouth of the Rhône were laid the foundations of two great mercantile cities. After the conquest of Britain a stream of Roman merchants and artisans poured themselves over the new field, and a number of towns—London, Bath, St. Albans—were formed as "the new result of freedom of traffic and immigration." The whole ancient world, which we think of as devoted to war and conquest, addicted to religious rites, absorbed in political struggles, or producing and enjoying immortal works of literature and art, had its existence based on industry and commerce, as the existence of the individual is based on hunger.

The modern world has been built up on the same foundation. The Venetians continued the eastern trade of the Roman Empire, and everywhere in the Levant left colonies. Portugal and Spain, with their ports opening on the Atlantic and inviting to discovery,

were the first to take the colonial field. The invention of the astrolabe and the discovery of the magnet made distant voyages practicable. All through the fourteenth and fifteenth centuries they stretched ever farther the scope of their trade till they had annexed the Atlantic islands, begun settlement at the southern cape, and laid the foundations of those colonies their shadowy claims to which (in Mashonaland) for some time resisted, a few years ago, the more invincible assertion of British armed occupation. Columbus's great voyage of discovery was but an extension of shorter trading voyages, and one of his three ships was equipped by merchants. Dutch colonies were still more an extension of Dutch commerce; they were planted mainly under the auspices of chartered companies, and while Spanish and French colonizers threw a glamour of religion over their undertakings, and Swedish and English colonies were often largely philanthropical, trade has ever been the chief, almost the sole, object of Dutch colonization. The West India Company founded New York, which was for years no more than a place of meeting where fur traders exchanged European commodities for skins, and the commercial agent of the company was its first governor. Canada was won for civilization by the same agency. Cartier's second expedition, which gave Canada to France, De Monts's and Champlain's were fitted out, in whole or part, by Breton merchants of St. Malo. Even the French Company of the Hundred Associates, which set the seal on the colonization of Canada and had Richelieu and princes of the blood for figureheads, was financed by merchants. Companies of the East Indies and the West, of the North, the Levant, and Senegal were formed in France in rivalry of those in England and Holland. The commercial conquest of Algeria and Madagascar was attempted by such companies two centuries before it was finally accomplished. But the tale of the foundation of colonies by commerce would be too long to tell. Not only the origin but the extension of colonial possessions are the work of commercial enterprise. Africa is at this day being colonized by chartered companies. Governments are deliberately colonizing and annexing to create markets. "Trade follows the flag," says Lord Salisbury. The French admit that no Platonic views but the need of openings for trade lies behind their late-born colonizing ambition; and Señor Canovas del Castillo avowed that Spain is making desperate efforts to keep Cuba and the Philippines not only for historical and sentimental reasons, but as Spain's last markets. What needs to be noted here is that the commercial colony, like the adventurers' and the fisheries colonies, is at first mainly asexual. The merchants who engineer them do not themselves go out to them; the traders do not at first permanently settle; there are

few women, and few children are born. Not out of such beginnings will a sound colony grow; not out of such materials can a normal society be built up. Commerce alone can not generate a true colony.

The traders desert the coast, and the more daring become hunters and trappers like the natives. This pioneer form of colonization is best seen in the *coureurs de bois* of old Canada—bold, adventurous men who had broken away from the restraints of civilization and plunged into the free life of the forest. They intermarried with Indian women, and their half-breed sons formed the *personnel* of the companies which controlled the fur trade for two centuries. Their meeting places with the Indian trappers were scenes of drunkenness and debauchery which threw the missionaries into despair. They jealously guarded their game preserves against the approaches of settlement. It was a degraded type of civilization, and, though it was the base, it was never the root of Canadian society. Not out of it could a true colony spring.

The big-game hunters of old days were men of a similar type, and were at least the beginners of the French colony of Louisiana. The big-game hunter of to-day is an Englishman or a Frenchman in whom the instincts of the savage periodically break out under a polished surface. One of the best specimens of the race, Mr Selous, claims that such men rank with missionaries as pioneers. The big-game hunters, he contends, opened up Rhodesia. The hunters of gorillas in the south and of lions in the north of Africa have been the precursors of settlement. But they have seldom themselves settled in the country they roamed over, and left few descendants to inherit their strength and courage.

Often associating with the hunters and trappers and merchants, and sometimes (like Joliet, the discoverer of the Mississippi) differentiating from them, are the explorers. An adventurous race, who traverse continents while the hunters scour kingdoms, the Ibervilles and La Salles, the Stanleys and the host of African and other travelers are the indispensable forerunners of annexation. Baker and Speke and Grant almost compelled the English occupation of Egypt. European travelers of many nationalities led inevitably to the wholesale partition of the Dark Continent. Missionaries sometimes accompany them, as Marquette did Joliet, or they sacrifice, like Livingstone, their own high calling to the broader vocation of the explorer; or they follow in his track, as three hundred missionaries arrived in the wake of Stanley's explorations; or, themselves the first explorers, they found villages, as the Jesuits did all over Canada and in Illinois and Michigan, some of them to become centers of colonization or great cities like Montreal; or they occupy and administer wide territories like Paraguay; or they pioneer civilized

settlement, as in Algeria and Madagascar, throughout the south seas and the far East. Sometimes, it must be sadly confessed, they make settlement practicable by emasculating the natives, as the Jesuits the Hurons and English missionaries the Maoris. But none of these classes are by themselves colonizers. They do not permanently settle, and the missionaries are as jealous as the fur traders of the advance of European occupation. Many of them, in North America and New Zealand, have advocated and encouraged the most fatal of all measures to a true colony—the formation of a race of half-breeds.

Hunting passes into pastoral pursuits by the domestication of the animals captured, as slavery arises out of war. The Greek colony of Cyrênê and its offshoots, Barka and Hesperides, were stock colonies; but the first settlers being exclusively men, they intermarried with the natives, and the true colonization dates from a later settlement of both sexes. The drovers of reindeer and the pastoralists of the Alps are in like manner male groups. Cattle-breeding northern Australia is still in the polyandrous condition of having ten men to one woman, and that was probably near the ratio of the sexes in the early days of the country. It is apparently the same on the *estancias* of Brazil, and Darwin states that "these Spanish colonies do not carry within themselves the elements of growth." Yet they lay the foundations for normal societies. What Bancroft says of the herdsmen of Carolina is true of all countries: they are "the pioneers of colonization in the wilderness." Sheep colonies, like New South Wales, are a stage nearer complete self-propagating societies than cattle colonies like Queensland. Shepherds and shearers are long semi-nomadic, and the squatter is sometimes the only family man; but villages grow up at the confluence of grazing runs to supply necessaries, shoe horses, build and repair, bait and accommodate. The "station" and its lord may be the true social nucleus, but expansion arises from the village with its families and rudimentary industrial organization.

The most advanced and most potent of all the pioneer types of colony alone remains to be mentioned. The mining colony is not a modern invention. Phœnician Cadiz and Græco-Italian Cumæ were, the one commercial and the other agricultural as well. But Athenian Amphipolis, with its auriferous and argentiferous mountains, must have been settled for its mines, and barren Thasos, like the adjacent Thracian mainland, must have been colonized by the Phœnicians, as afterward by the Greeks, for its gold mines alone. Gold discoveries on a great scale are nevertheless modern and characterize two of the three great epochs of colonization. The South American exodus of the sixteenth century and the Australian and African rushes of the nineteenth have this feature in common that

they had in themselves no principle of expansion. The mining settlement is a mechanical formation and not an organic growth. Its rise has been too often observed to need description. A lucky prospector finds a gold- or silver-bearing reef, possibly in a district indicated by a geologist, who is thus also a pioneer. The news spreads like the cry of fire. From the adjacent colonies and distant countries a mob of adventurers and old gold diggers crowd in and clamor for concessions. The field is soon white with tents, huts spring up as by magic, a "store" is set up, a hotel follows or precedes, and in a few weeks a wild-cat township comes into existence. It grows with the growth of the "diggings," and declines with them. When they are exhausted, the fortuitous concourse of its inhabitants scatter as swiftly as they came, and the township leads a death-in-life existence on the tailings; or, if the country is favorable, the solider portion of the miners take to agriculture or industry, and the town becomes a manufacturing or distributing center. Denver, Ballarat, and Johannisburg are types of the miner's camp turned into flourishing cities. South America was founded as a series of gold and silver colonies, and saltpeter has lately established an English colony in Bolivia. The gold discoveries of 1851 "precipitated Australia into a nation." In still more recent days silver has generated several of the Western States and built up a great political party. Within the last decade gold has transformed a scattered population of farmers and big-game hunters in South Africa into a warlike republic. The precious metals thus start colonies, or give them an impulse when founded. They may even change their base. A pastoral and agricultural country, like Victoria, may be converted into a commercial and industrial country. Other results are more questionable. Population is attracted, but it is disorderly and without cohesion, and state industries have to be created for the support of the multitudes whom the exhaustion of the mines has thrown out of employment. Hence arise huge loans and oppressive debts, protective duties, overgrown cities and plethoric communities, where the brain is overfed and the extremities are starved.

These are, roughly outlined, the pioneer types of settlement that constitute the first chapter in the history of all colonies and countries. They have been assimilated to the asexual method of reproduction because they belong to a low grade of organization. They are initiated mainly by men; they do not, taken singly or all together, form a perfect social organism or a self-subsisting society; and they are incapable of a prolonged existence.

Asexual passes into sexual reproduction by a series of gradual transitions that are no longer a mystery; they have been well dis-

criminated by Professor Le Conte. The mechanical rupture of simple organisms is followed by budding on any part, that by budding on a special part, that by the formation of an internal organ, which in a still more advanced stage generates at once male and female cells; differentiated sexual elements are next produced by independent sexual organs, which are ultimately assigned to separate individuals. Asexuality passes through bisexuality into unisexuality.

If the analogy between the individual and the society is much more than an analogy; if it is an identity; if social processes are but a continuation and expansion of animal processes, every one of these transitions should find its counterpart in the genesis of colonies. Coloniology, however, is itself still in the pioneer stage and must be content with hinting at resemblances that future Le Contes will demonstrate. The fission of unicellular organisms is paralleled by the "natural fracture" of Greek and Phœnician urban states. Gemmation at any point finds its analogue in the way by which continental countries plant colonies, or colonies plant fresh colonies, in contiguous territory. Specialized gemmation may have its parallel in the limitation of emigration from maritime countries to certain ports. Internal gemmation may take place in societies when emigration is engineered from within, and the internal bud becomes a sexual organ when emigration agencies are formed. The dominating races—the last conquering immigrants—in any country are the male elements; the subjugated races are the female; emigrants at first are chiefly of the former, but the latter ultimately join the stream. Lastly, when England sends to the United States its enterprising and Germany its revolutionary citizens, while Celtic Ireland sends, doubtless with many of a different sort, its pick-and-shovel man and its serving woman, there is an approach to the marriage of nations. State union, indeed, for the purpose of propagation took place in very early times. Three Phœnician cities jointly founded a third, where, however, the three colonies led a semi-independent existence side by side. Many Greek colonies were established by two mother cities; but all of these were of the same stock, and their association rather resembled the conjugation of infusorians. Had Corinth (of the masculine Doric race) joined Ionian Miletus in colonizing Sicily, it would have been a true sexual union.

The acquisition of the secondary sexual attributes by peoples will, no doubt, be yet shown to follow a parallel course to their acquisition by the individual. The lowest races seem to be everywhere sexless. The Australians and Fuegians and Veddahs exhibit no masculine qualities; they are not conquering, inventive, progressive. Among the Red Indians we may observe the beginnings of differ-

entiation: the Iroquois and the Hurons subjugated other tribes, and one such defeated tribe was condemned to be called "women." Both of these peoples, again, voluntarily or not, became females to the invading English and French. The French are still males to the Arabs and Malagasy; they were lately males to the Alsacians and Lorrainers, whom they so impregnated with their civilization that the Germans can only re-Germanize their own countrymen by recolonizing the two provinces. Can a nation lose its sex? Prince Bismarck, who is a noumenalist among statesmen and goes to the root of the matter, as another retired statesman is content with exploring a wide surface, describes the Celts and Slavonians as feminine, while the Germans and English are masculine. Were the French conquering and creative while they were still led by a Teutonic aristocracy; and is it because they deposed their rulers in 1789 and 1830, and allowed the Celtic substratum to come to the surface, that they have lost the leadership of Europe in war, science, and philosophy? Did Spain cut her spermatic nerve, so to speak, when she killed off her Protestants and freethinkers? If it was so, we might describe national sex as being produced by the emergence, commonly the immigration, of a conquering class or race. The effects are very different in different cases. The Hindus imposed their government, language, and religion on the races of India; the Hellenes on the Pelasgians. The Goths and Germans imposed their government and laws on the Iberians and Celts, accepting the language and religion of the indigenes, which, however, were those of Rome. A race may thus be at once male and female, as France receives her militarism and her music from Germany, while she communicates her plastic and literary art. All existing and extinct civilized peoples are or have been bisexual. By the adventurous male elements in them they found pioneer colonies (those of our first or asexual division, which might perhaps have been called male colonies, like certain low organisms). By male and female elements together they build up and organize the higher colonial groups belonging to the second or quasi-sexual division, in which each colony is a more or less complete reproduction of the mother country, and is therefore capable of self-subsistence. Here, again, as in the first, the arrangement is a compromise between the logical and chronological order.

1. It may seem an abuse of language or an error in classification to place *convict colonies* in this division. The foundation of such settlements might rather be considered the expulsion of feculent matter from the social organism than the planting of the healthy germs of a new national life. Yet low as it is—far lower than the higher groups of the pioneer division—the convict colony bears within it the potentiality of complete development. Crime, unhappily, is

confined to no class. A convict ship, therefore, carries out to new lands representatives of most of the ranks, professions, and occupations that go to make up a complete society. Time being given—and a long time, for its growth is abnormally slow—it will develop, if only into the apelike caricature of the country that gave it birth. Colonies that have a convict origin, or have at different stages been inoculated with convictism, are numerous. A number of Greek and Eastern communities seem to have had no better beginnings. The depopulated town of Dymê, in Achaia, was settled by Pompey with pirates. A robber chief reconstructed on the Galatian frontier the decayed town afterward named Juliopolis. Five of the Ægean islands were Greek penal settlements. A portion of the bands that invaded England were pirates; the aristocratic and hygienic Isle of Wight was made by the Jutes a voluntary convict settlement. After the failure of Hispaniola, Columbus had partly to content himself on his third voyage, as on his first, with prisoners respited from the gallows. Brazil was at first a penal settlement, and it was afterward reenforced by a very superior kind of "convicts"—the victims of the Inquisition. The equipment of the early expeditions to Canada was of like kidney. Roberval was granted permission to ransack the prisons and take thence thieves, homicides, and fradulent debtors. "Banished men and the usual complement of villains" made up De Monts's expedition. "Scoundrels of the deepest dye" crowded to Laudonnière's standard. Captain John Smith's company consisted in part of felons and vagabonds. Eighty convicts were among the first French colonists of Louisiana. All through the seventeenth century "Newgate birds" were shipped to North America, especially to Maryland and Virginia. North Carolina, like ancient Rome, was "the sanctuary of runaways." It somewhat moderates our admiration of the nobly conceived project of Gustavus Adolphus to find that the Swedish settlement on the Delaware was designed in part as a penal colony. But it was toward the end of the last century and in the first half of this that penal colonies were established on a colossal scale. For the long period of fifty-two years (1788–1840) New South Wales was the recipient of every variety of convicted felon—some fifty thousand being dispatched to it from first to last. In 1803 some of the more incorrigible specimens were selected and sent to Van Diemen's Land, which continued to receive them for half a century. Twenty-one years later the same abandoned classes were shipped to the colony afterward named Queensland, but only for eighteen years. A more appalling origin for a colony can not be imagined, and the tragic page of history is blackened by no more sickening horrors than deface the early annals of Australia. Yet so little were the consequences of the transporta-

tion system dreaded that West Australia, where golden Coolgardie had not yet been discovered, petitioned to share in the indirect benefits of it, and was a convict settlement from 1850 to 1868. A sanguine speculator only ten years ago proposed to colonize the Bay of Plenty in New Zealand with the sweepings of English jails and workhouses. It must be admitted that the apparent results go far to confound the criminologist; more law-abiding communities than these do not exist. What miracle has been wrought to bring wheat from tares and grapes from thistles? It is not enough to say that the flood of immigration to the gold fields has swamped the penal elements. Tasmania has had little gold and but few immigrants, yet Tasmania is as respectable as New South Wales. The self-destroying power of evil will account for the disappearance of much: there were always more men than women, and many of the women were barren, as is usual when both sexes are profligate; there were usually few children, and the convicts were not long-lived. On those that survived, and on their offspring, social influences were immensely powerful. As the chemistry of the earth (in Whitman's poem) absorbs the products of putrefaction and decay, and gives them back as luxuriant vegetation, the higher chemistry of an orderly and moralized society assimilates all that is good in disease and crime by utilizing the criminal and repressing and ultimately extirpating his antisocial impulses. These admissions being made, an irreducible residuum remains. The "white trash" of the Southern States has long been affiliated on the transported English prisoners of the seventeenth and eighteenth centuries. Mr. Eggleston finds further traces of them in the "hereditarily pauper and criminal classes" of the North. Professor Fiske has come upon the tracks of the "mean white" in "little isolated groups of wretched hovels" among the mountain villages of New England. And other observers, forgetting the corruption of human nature and its perpetual downward tendency, have been tempted to discover in Australian towns and villages unmistakable evidence of convict ancestry.

2. Often almost as low in actual working, but unquestionably higher in theory and result, are the many *military* colonies through which rather the imperial than the properly colonizing nations have built up their empire. Their objects are everywhere the same: to hold in permanent subjection a country that has been conquered by arms, not won by commerce or industry, and to repress the incursions of hostile peoples. They are what Cicero called them, *propugnacula imperii*—"outworks of empire." The Assyrian colonies seem to have been of this type. The settlements differ somewhat in character, according to the quality of the troops employed. The lowest of them may have been the Nubian people whom Diocletian

transplanted from the Libyan Desert to Syene in order to guard the frontier, and the next lowest the strange colony of Saracens whom the freethinking Frederick II planted in Apulia. Much higher were the colonies of vanquished Goths and Ostrogoths, Franks, Gepidæ, and Vandals whom the Roman emperors settled on the frontiers —in Spain and Britain, Africa and Illyria and Asia Minor, Greece and Palestine. Whether as legionaries or veterans, these soldiers seem to have been accompanied by their families, and where they did not drive away the indigenes (as they did at Camolodunum, in Britain) they were granted lands and supplied with the instruments of tillage. Some of these military settlements, like two of the Numidian colonies, became centers of Roman civilization; others, like Chester, Gloucester, and Colchester, grew into prosperous towns; still others—and these perhaps the majority—like the colony of veterans planted by Hadrian on the desolate site of Jerusalem, did not thrive. Higher yet than these were the towns settled with Greek soldiers by Alexander and the Alexandrids. Of the Macedonian, Thessalian, and Thracian, Thessalonica was alone important; some of those in Asia Minor were in later times flourishing. Military colonies are not unknown in mediæval and modern Europe. The Frank kingdoms of Jerusalem and Cyprus, the principalities into which the Eastern Empire was partitioned, and Constantinople itself, where in the beginning of the thirteenth century there was a Frank colony of fifteen thousand souls, were all military colonies, though of brief existence. Under the Swabian emperors, small colonies of noble and peasant Germans were established in Davos and other Alpine districts in German interests. Spain conquered South America by planting a series of military colonies. France, always more conquering than colonizing, is but slowly converting Algeria from a military into an industrial colony. Even colonizing England has planted military colonies in Ireland, Nova Scotia, and Ohio, besides having temporary camps on her frontiers where towns grow up, as at Raglan and Otahuhu, in New Zealand; and the pensioner settlement of Onehunga may be taken as an image of an ancient Roman colony of veterans.

3. We seem to rise considerably in the scale as we leave behind us colonies founded on the lust of conquest, and arrive at colonies whose formation was governed by *political* motives. They are always more or less collective; they sometimes take place *en masse;* they are often directed and organized; and they are homogeneous. Involuntary migrations are among the earliest of them, as when the Achaians and Œnotrians, driven out of the Peloponnesus and Italy by the Dorians and wild tribes from the Apennines, emigrated to Sicily. The best known, and more voluntary, are those of the

Ionian cities of Asia Minor, after their subjugation by the Lydians and Persians. A collective Pan-Ionian emigration to Sardinia was proposed, but a series of sovereign states was too disunited for such heroic action, and it took place piecemeal. The whole of the Phocæans, taking with them their wives and children, their furniture, and the decorations of the temples, sailed for Sardinia, but more than half of them lost heart and returned to the subject city which they had sworn never to behold again. The inhabitants of Teos emigrated to Thrace and founded Abdera, to the Bosporus and settled Phanagoria. Many of the Samians fled to the promised land of Cyrene and some to Sicily. Other cities were almost depopulated. After the captivity, and still more after the conquest of Jerusalem, Jewish colonies were similarly dispersed over the greater part of the Greek and Roman world. The Albanians of Scanderbeg, who so bravely resisted the Ottomans, took refuge in Apulia. The Salzburgers described in *Hermann und Dorothea*, and the noble *émigrés* of the Revolution, with their headquarters at Coblenz, are recent examples of the collective migration of political colonies. Many Greek colonies were the offspring of internal dissensions in the parent state: Theræan Cyrene is doubtfully said to be one; Syracusan Himera is another. Roman colonies of the same origin were often organized by popular leaders as a safety valve, like those of Carthage and Narbonne by Caius Gracchus. The loyalists, who to the number of forty thousand emigrated to Canada and there settled Ontario after the Declaration of Independence, are a striking example of purely political colonization. But it is rebellion oftener than loyalty that founds colonies. The discontented New-Zealanders who, some fifty years ago, projected an independent republic somewhere in Oceania, anticipated (in imagination only) the Queensland journalist who, to escape from the tyranny of British ideas, emigrated a few years ago with a band of sympathizers to the wilds of Paraguay, there to found, amid impossible surroundings, the Utopia that is now struggling for existence.

4. It may seem a mere refinement to distinguish *imperial* from political colonies. Yet there comes a time in the history of great nations when a spirit of proselytism takes possession of them, and they are irresistibly moved to stamp their institutions and ideas on only half-reluctant peoples. The Athenian colonies planted by Cimon and Pericles, when the queenly city was at the height of her power, were to some extent of this description. More truly propagandist were the five hundred urban communities, with the imperial cities of Alexandria, Antioch, and Thessalonica at their head, founded by conquering Alexander and his victorious generals. Nothing less than the Hellenization of the known world was their

aim. Their immediate success was wonderful; their ultimate success has been in a manner complete. With the same systematic activity, continuous, homogeneous, and conscious of its aim, the earlier emperors pursued the Romanization of the world. Cities like Nicopolis and Marcianopolis were founded; Corinth and Patras and Jerusalem were raised from the dust; old provinces were colonized afresh, and newly discovered countries thrown open to settlement. Yet the panegyrist of the empire has to admit that the results attained were in part illusory. The flourishing industry and commerce, literature and art were no products of despotism, but of the earlier free institutions; and the new foundations were artificial and without true life. In modern France, not commerce only, but far-reaching schemes of dominion, dictated to Colbert the annexation of Newfoundland, the purchase of the West Indies, the conquest of Senegal, and the systematic colonization of Canada and Cayenne; not gold, but visions of empire, dazzled the imagination of La Salle when he colonized Louisiana. A school of French publicists optimistically ascribes the present colonizing fever in their country to "an impulse of patriotic idealism." England seems only lately to have become fully conscious of the vocation assigned to her by Hegel seventy years ago as "the missionary of civilization"; and Lord Rosebery's description of the British Empire as "the greatest secular agency for good existing among mankind" is no longer a hyperbole. Germany and Italy, with doubtful success or total failure, follow in her footsteps. Even the United States, once a self-contained commonwealth, now exercises an effective suzerainty over the South American republics, and, finding a continent too narrow for her ambition, annexes the Sandwich Islands. We are at the dawn of a new era of colonization.

5. Early in the century a group of French writers, of whom the most famous was Chateaubriand, reacting from the materialism of the French Revolution, proclaimed Christianity the source of European civilization. A generation later another idealist, Edgar Quinet, generalized the conception, and eloquently exhibited religion as the generating principle of every society: the source of its political institutions, art, literature, and philosophy, the secret of its life and the key to its history. In due time comes the scholar, and the late Fustel de Coulanges applied the view to the civilizations of India, Greece, and Rome. The other day Mr. B. Kidd placed the doctrine on a physiological foundation. But if this theory is true of society in general, it must be true of those special societies named colonies and (what is here in question) of *their* genesis. As has been seen, colonies have many origins. Yet religion is one of them: there are *religious* colonies. The religious sentiment has at all times played a

large part in colonization. Phœnician Melkarth was the companion and protector of Tyrian colonies. The Hebrew colonization of Palestine was God-guided. Apollo, through the Delphic oracle, was the instigator and director of not a few Greek colonial settlements. Sometimes he nominated a founder; of two cities the god himself was "œkist." Perhaps we may say that all the later Greek and Roman colonies were placed under divine guardianship, but religion was too closely bound up with government to be of itself the basis of a colony. It is in modern times that the maturity of the religious sentiment has given rise to independent social formations. The great Puritan settlements of New England are unapproachable examples of the strength, cohesion, durableness, and power of generating new communities which that sentiment can give. Its complexion may vary. There are many degrees between the ecclestiastical theocracy of Massachusetts and the secular theocracy of Pennsylvania and west New Jersey, with the transcendental theocracy of Rhode Island as a middle term. In east New Jersey three distinct types were blended. Where religious enthusiasm does not generate colonies, it endows them with a principle of life. Commercial New York might have remained an inorganic community of traders but for the influx of exiles from all Protestant Europe, who gave it the energy of a world-city. If Canada was founded by fishermen and adventurers, it was built up by religious zealots. The sturdy communities of French farmers and Dutch Boers in South Africa had religious dissent as their *raison d'être*, and still have a strong religious faith as their chief social bond. In our own time two remarkable colonies have been established in the south seas on religious or at least ecclesiastical principles. The Otago Association and the Canterbury Association, which settled the southern parts of New Zealand about the middle of the century, were respectively the outcome of the disruption of the Kirk in 1843 and of the Tractarian movement in the same decade. Both societies had all the characteristics of church settlements: the emigration was homogeneous and of an excellent class; the clerical element had a large share in the government; and many of the institutions had an ecclesiastical tinge. But neither of them was a theocracy even of the mitigated seventeenth-century type, and the lapse of thirty years sufficed to show how ill-adapted were both of them, as originally designed, to the new surroundings. Yet the large and elevated part played by these communities in the history of New Zealand, the importance of similar smaller nuclei in other Australasian colonies, the immense influence of the Puritan, Presbyterian, and Quaker States in North America lend no small countenance to those who believe, with Quinet, that religion is "the substance of humanity."

6. Even in *philanthropic* colonies religion is an auxiliary. Georgia was projected partly in the interests of "the persecuted Protestants of Europe," and was promoted by the Society for Propagating the Gospel. Whitefield and the two Wesleys were among its first evangelists, and a body of German Moravians formed a settlement in its territory. These religionists even sought to turn it into a religious society, but found their heterogeneous materials refractory. It was the flame of philanthropy, burning strong and clear in the breast of James Oglethorpe, that gave the colony its distinctive character. The relief of the poor and the oppressed is a motive that places it higher than any ecclesiastical foundation. Baron Hirsch's Jewish colonies may be equally religious and humanitarian. Miss Rye's and other Canadian settlements are the offspring of pure philanthropy, still subsidized mainly by the orthodox and the devout.

7. Lastly, there is a type of colony peculiar to our own time and impossible earlier, which we may call (for want of a better name) *sociological.* It was the invention of one who to the reflective faculty of a De Tocqueville joined the executive capacity of a Turgot, and who had the good fortune, denied to both, of seeing his conceptions realized. We shrink from the Darwinian ascription of so much to "accident," but accident plays as large a part in history as in nature, and it was accident which constrained Edward Gibbon Wakefield to throw his energies into the work of colonization. Having examined minutely and considered profoundly the origin and circumstances of existing colonies, he came to the conclusion that a colony, to be successful, must faithfully reproduce the essential members of the mother country—a conclusion in strict conformity with the biological analogy. The superior classes had been lacking to previous emigrations; to induce them to emigrate, and to keep the whole administration in their hands, he proposed to abolish the wholesale granting of lands, or the selling of them at a cheap rate, and to dispose of them at a price which would reserve them for the rich; with the proceeds of the fund so raised the poor were to be sent out as laborers and artisans. State churches and an aristocratic form of government were necessary corollaries. Five colonies were (1837–1851) actually founded on this basis in South Australia and New Zealand. They were administered by men the most capable who have ever governed these countries; the settlers were of the best kind; and they were powerfully aided in England. But the circumstances were unfavorable. The natives in New Zealand were hostile, and the local government was implacably opposed to the growth of an *imperium in imperio.* The attempt to reproduce in a new country a moribund artistocratic society was foredoomed to

failure; the company surrendered its charter, and the settlements were absorbed by the New Zealand Government. They nevertheless contributed greatly to the colonization of a country then covered with forests and occupied by cannibals. Together with the two ecclesiastical provinces of Otago and Canterbury, they have communicated the energy and self-reliance that distinguish the "Britain of the South."

If the foregoing classification of colonial origins be correct, two conclusions necessarily follow: First, colonial societies in their mature state have not been developed out of the primitive loose aggregations of various kinds which everywhere sprang up in favorable circumstances, but are rather founded upon them, as the Pliocene on the Miocene strata. Next, the part which intention and design, conscious and organized action, have played in social evolution is greater than sociologists have hitherto been willing to admit. And as, in virtue of the law that the development of an individual is a recapitulation of the development of its ancestral species, the genesis of colonies is a rehearsal of the genesis of all societies, social origins will have to be studied a little less from imagination and a good deal more from history than has yet been attempted.

WEATHER FORECASTS: THE MANNER OF MAKING THEM AND THEIR PRACTICAL VALUE.

By E. J. PRINDLE.

WE are not always conscious of the great influence which the weather exerts on our affairs. Fair weather gives zest and interest to everything, while dark clouds depress us and take the life and sparkle from that which was before most attractive. In cases of severe illness the weather sometimes makes all the difference between life and death. Our emotions are largely under its control. The farmer's first thought in the morning and his last consciousness at night relate to the weather. The sailor, the pleasure seeker, the shopper, and the builder are all deeply concerned with the weather, to say nothing of the children, whose lives are quickly limited to the four walls of the house on the approach of bad weather.

It is a matter of so much concern that our Government spends annually about nine hundred thousand dollars for the maintenance of its Weather Bureau, in order that we may know a few hours beforehand what to expect of the elements.

The first attempt at scientific forecasting of the weather was the result of a storm which, during the Crimean War, November 14,

1854, almost destroyed the fleets of France and England. As a storm had raged several days earlier in France, Vaillant, the French Minister of War, directed that investigations be made to see if the

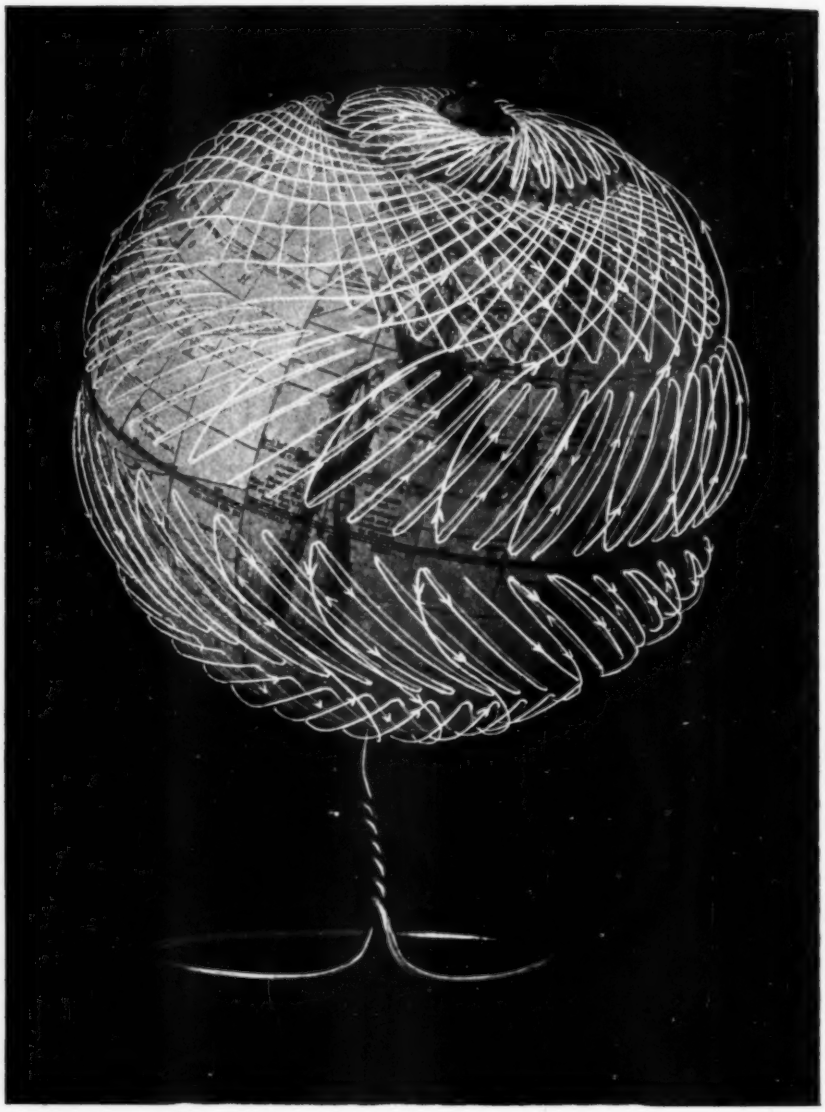

FIG. 1.—GENERAL CIRCULATION OF THE ATMOSPHERE.

two storms were the same, and if the progress of the disturbance could have been foretold. It was demonstrated that the two were in reality one storm, and that its path could have been ascertained and the fleet forewarned in ample time to reach safety.

In order to intelligently predict the weather for even a small section of the country it is necessary to know the conditions that exist over the whole United States, and over as much of the rest of the world as possible. The Weather Bureau receives observations from one hundred and fifty-four stations. There are four hundred and eight-five miles of telegraph lines and submarine cables operated by the Weather Bureau for connecting with such points as Cape Hatteras, Nantucket, and islands in the Great Lakes and on the Pacific coast.

To understand the plan of work of the Weather Bureau it will be necessary to enter to some extent into the laws of the weather; but it will not be found difficult to see how the forecasters of the bureau, with their greater knowledge in the same directions, are able

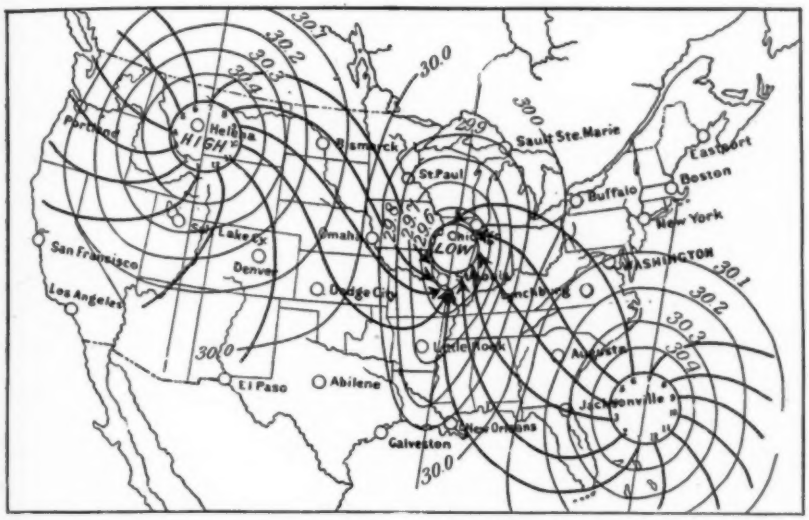

FIG. 2.—SHOWING ISOBARS AND WIND LINES.

to foretell the weather correctly, as they do, in over eighty-two per cent of the predictions. Strange as it may seem, the weather does have laws, laws that are inflexible, so that, if the conditions are correctly understood, the changes in the near future can be confidently predicted. All of these laws have not, however, been discovered, and some that are well known have yet to be satisfactorily explained.

Primarily, the winds result from the sun heating the tropics to a much greater extent than it does the polar regoins, causing the air to rise in the tropics and flow toward the poles at a high altitude; from which regions it returns toward the equator along the surface of the earth. Owing to the rapidly lessening circumferences of the parallels of latitude toward the poles and other causes, there is an ascending belt of air near the parallel 64, toward which the surface wind

blows from each side, and a descending current of air near parallel 32 of each hemisphere, from which the air flows north and south.

Friction between the surface of the earth and the atmosphere tends to carry the air with the earth in its rotation. As the velocity of the earth's surface is nothing at the poles and increases toward the

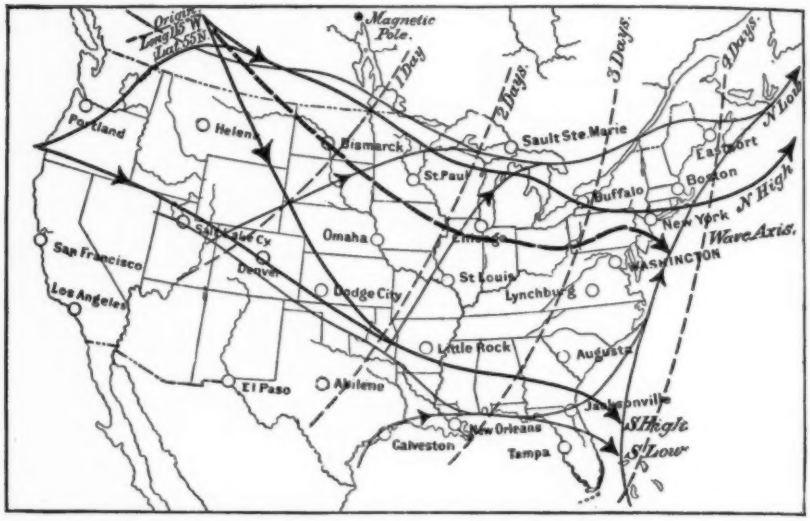

FIG. 3.—SHOWING THE ORIGINS OF THE HIGHS AND THEIR PATHS.

equator, those winds which blow toward the equator will lag behind and have a westerly direction, and those that blow toward the poles will retain their greater velocity of the lower latitudes and travel faster than the more northern parallels, resulting in an eastward direction over the earth's surface.

In the temperate zone of the northern hemisphere there is a general northeasterly drift of the surface atmosphere at a fairly regular rate of motion, and this causes our storms almost without exception to travel from west to east. This eastward tendency of all atmospheric disturbances is the basis of all predictions.

In the great ocean of air, as in the ocean of water, there are constantly occurring waves and hollows, or areas where the air is piled to an unusual height, showing increased pressure on the barometer, and areas where the height and pressure are less than the normal. These high and low areas, or "highs" and "lows," as they are technically known, travel in a general northeasterly direction. In Fig. 2 is shown an actual case of a low between two highs in the United States, and it is extremely interesting to notice the laws of the winds around them. The finer, oval lines are used to connect all points having equal barometric pressure. They are known as "iso-

bars." The heavy, arrow-tipped lines show the actual direction of the wind as it was observed on this occasion. It will be seen that the winds flow spirally outward from the highs in the direction of motion of the hands of a watch, while they blow from the high spirally inward toward the center of the low in the opposite direction to that of the watch's hands. These same directions will always be found about a well-defined high or a low. A severe storm and a low will always be found together, and the law of the winds about a low enables navigators to judge of the direction of the center of the storm and to steer away from it in time to avoid disaster. The lows are called cyclones, because of the inward direction of their winds; and the highs are known as anticyclones, because the winds resulting from them flow outward.

The highs are caused by descending currents from the upper air due to increased density which results from cooling by radiation of heat from the upper air. The lows are caused by the air absorbing heat from large areas of the earth's surface where the sun has acted strongly. The heated air ascends and flows outward at the upper levels, reducing the barometric pressure. If the air is moist,

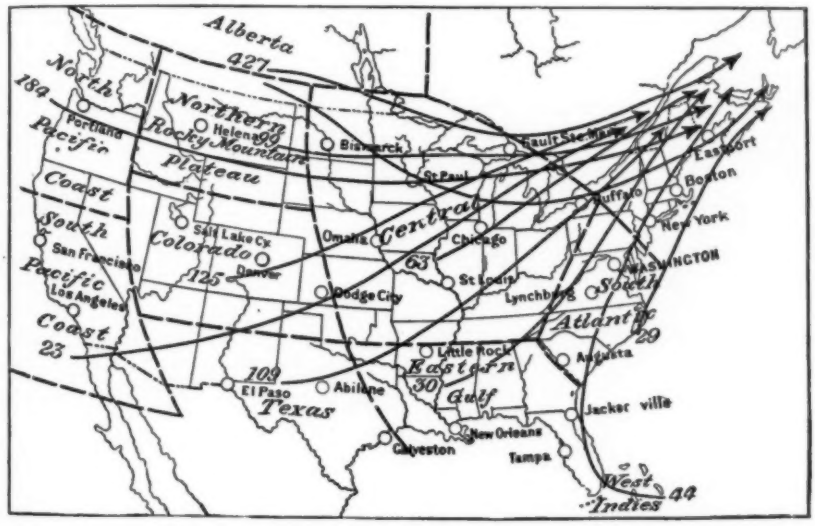

FIG. 4.—SHOWING THE ORIGINS AND PATHS OF STORMS.

when it rises under the action of heat, its pressure lessens until the moisture is condensed; and the liberated latent heat serves further to heat the air and increase the upward flow. The condensed moisture usually appears as clouds or rain.

The highs are found to enter the United States from only two points. In the winter they usually originate in Alberta to the north

of Montana, and they follow either of two well-defined paths in their eastern course. One path leads southeasterly to the Georgia coast, from which locality the high follows the warm, moist air over the Gulf Stream to the Gulf of St. Lawrence, there to pass beyond our observation (Fig. 3). The other path extends across the Great

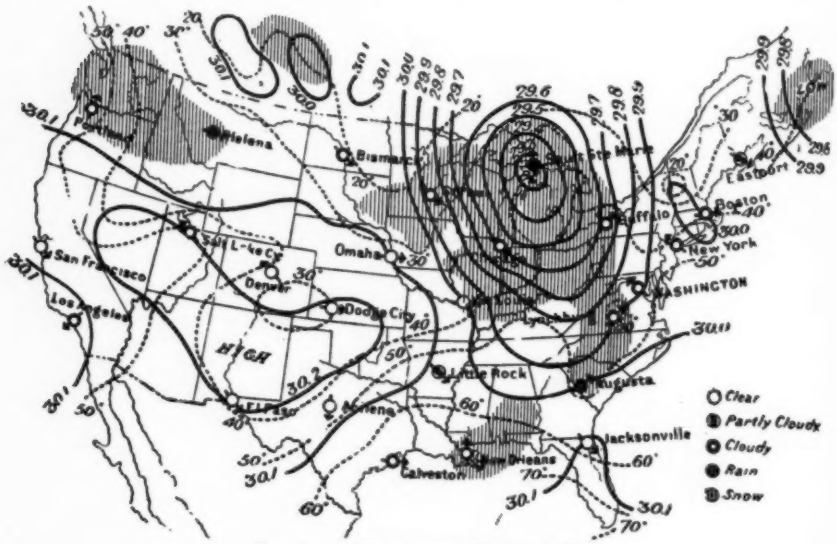

FIG. 5.—A NEWSPAPER WEATHER MAP.

Lakes and New England to the same destination. In summer the larger number of highs enter our country from the Pacific Ocean about the latitude of Oregon, and either pass northward along the Pacific slope, whence a crossing is made over the Rockies to the northern circuit from Alberta, or through the Salt Lake region to the southern circuit from Alberta. Having determined the circuit which a high will follow, and having found its rate of travel from observation, it becomes largely a matter of calculation to foretell its progress across the continent.

While the highs have only two points of entrance to the United States, the lows or storms originate in nine different districts throughout the country. In Fig. 3 the heavy full lines represent the paths of the highs. The lighter full lines indicate the origins and paths of the lows, and the heavy dotted line is the axis or path of the middle of the cold waves. It will be seen that the lows follow the two circuits, northern and southern, of the highs, and that they occasionally cross over from the southern to the northern circuit. Some of them originate in the West Indies and travel up the Atlantic coast.

Fig. 4 shows the nine districts into which the United States has

been divided with reference to the origins of storms and also the paths of the storms. All the paths cross New England, and the chart shows what a harsh, changeable climate this section has. There is no other region on the face of the earth, not even excepting Siberia, where there are such sudden and violent changes of weather as in New England. All storms that visit the United States cross New England and pass off toward the St. Lawrence Gulf, if they do not die out on the way. Lows move on an average at the rate of twenty-five miles per hour.

We have now seen that highs and lows have definite points of origin or entrance into the country, and that they follow well-established tracks. It is clear, therefore, how their location a few hours in advance may be estimated.

Highs are not usually accompanied by rain, but the temperature falls in advance of them as they pass over the country. The lows, on the contrary, are the storms, and usually carry rain with them. The greatest rainfall is usually to the northeast of the center of the low, and the low tends to move toward the point where there is the heaviest rain. The temperature of the air rises in the regions to the east of the low, and falls to the west of it.

Having located the highs and lows that exist and determined what paths they are likely to follow, from the laws that have been

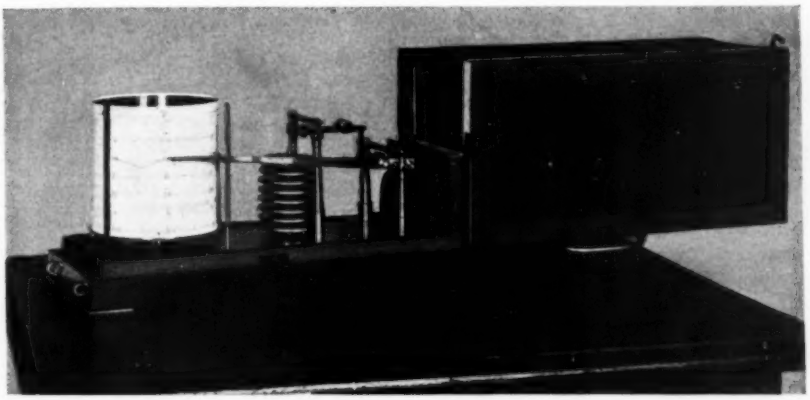

FIG. 6.—THE BAROGRAPH.

explained, it may be seen how the direction of the wind, the occurrence of rain, and the changes in temperature can be predicted (Fig. 5). Fig. 5 is a reproduction of a newspaper weather map. The dotted lines connect all points having the same temperature, temperatures ten degrees apart being chosen. The full lines are lines of equal barometric pressure, there being a line for each one tenth of an inch difference in pressure. The arrows fly with the wind. Rain

is indicated by the shaded areas. It can be observed how the winds blow with the hands of a watch around the high, which is central over New Mexico, and in the opposite direction about the low, which is central over Sault Ste. Marie. The temperature is higher to the east of the low, and falls behind the low and before the high in their eastward progress. The rain is seen accompanying the low and to the east of it.

For the purposes of forecasting it is necessary to know the barometric pressure, direction of the wind, and state of the skies. All this information is telegraphed to the Weather Bureau twice daily from

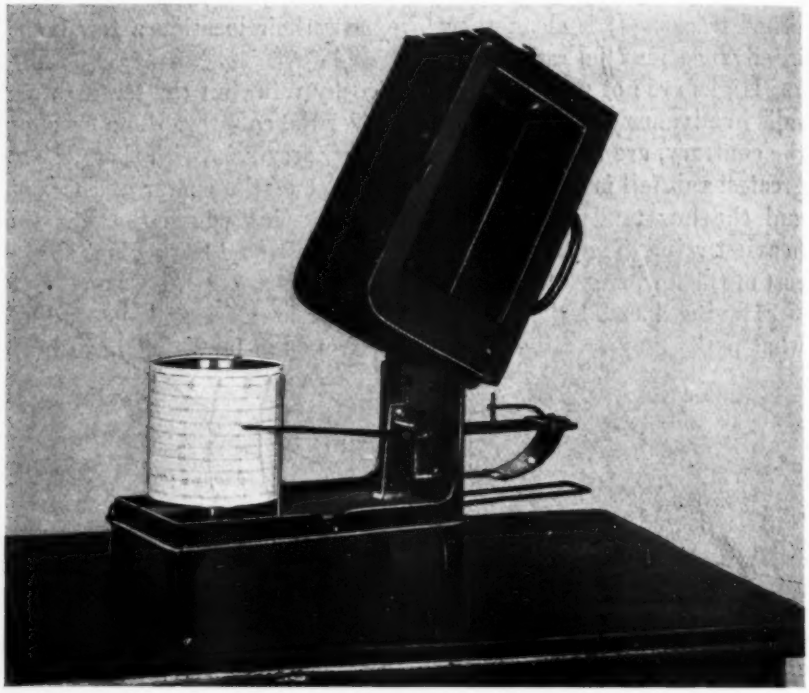

FIG. 7.—THE THERMOGRAPH.

each of the stations of observation, and all other telegraphic business must give way to this for the time being. Each message is, by means of a cipher, usually expressed in ten words or less. The observations are taken at 8 A. M. and 8 P. M., Eastern time. The results are exchanged with the Canadian Weather Bureau. The principal stations are provided with recording instruments, so that a continual record is kept of all these features of the weather. While the instruments appear complicated, they are based on principles that are easy of comprehension.

The barograph consists of a series of corrugated sheet-metal

cells placed one upon the other and connected at the upper end of the series to a system of magnifying levers that operate a pen. The pen point rests upon a sheet of paper which is held on a cylinder

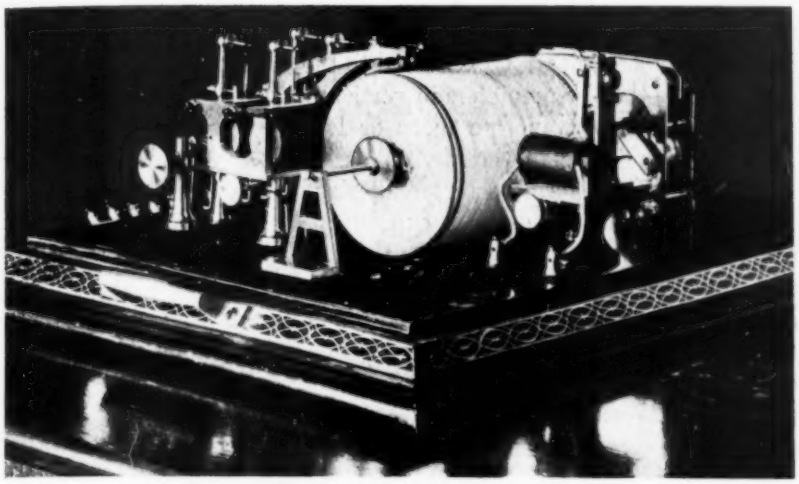

FIG. 8.—THE TRIPLE REGISTER. Front view.

having clockwork within it to give it a slow rotation. The varying pressure of the atmosphere causes the cells to contract and expand, and this motion, transmitted through the levers, causes the pen to trace a line on the graduated paper whose co-ordinates represent the pressure of the atmosphere at any given time.

The thermograph is somewhat like the barograph in principle. The element that is affected by the temperature is a metal cell that has the form of a curved and flattened tube, one end of which is secured to the framework and the other end connected by a link to a lever carrying a pen point. It has also a clock-driven cylinder with its graduated sheet of paper. The tube is filled with alcohol, and, as the liquid expands, it straightens the tube and moves the pen over the paper, making an irregular line that represents the ever-changing temperature.

The maximum and minimum thermometers record the highest and lowest temperatures respectively in the twenty-four hours. The former is an ordinary mercurial thermometer with the addition of a contraction in the tube just above the bulb. The heat forces the column of mercury past the contraction, but it can not return to the bulb when the temperature lowers. The minimum thermometer is an alcohol thermometer that has a colored glass float in the liquid. When the alcohol contracts, the skin of the liquid carries the float down with it; but, when the temperature rises, the float remains to mark the lowest temperature.

The amount of moisture present, or the humidity of the air, is determined by a comparison of dry and wet bulb thermometers. They are both ordinary thermometers; but the bulb of the latter is covered with muslin that is wet. In the latest form of instrument the thermometers are mounted on arms carried by a shaft that is rotated by a crank which is geared to the shaft. The motion of the shaft rotates the thermometers in vertical planes and causes the water in the muslin to evaporate more or less rapidly according to the amount of moisture in the air. This evaporation lowers the temperature of the thermometer; and, from tables constructed after long experiments, the degree of moisture can be determined by the difference in temperature between the two thermometers.

The direction and speed of the wind, the hours of sunshine and cloud, and the amount of rainfall are recorded by the "triple register." The instrument has a cylinder on which is carried a graduated sheet of paper for the record. The cylinder is supported by a horizontal shaft that is turned by clockwork. On the shaft is secured a spiral wire that engages grooves in a bearing of the shaft; so that, as the shaft turns, it and the cylinder are moved along. This would cause a stationary pencil to trace a spiral on the cylinder. The shaft carries two arms parallel to itself that pass

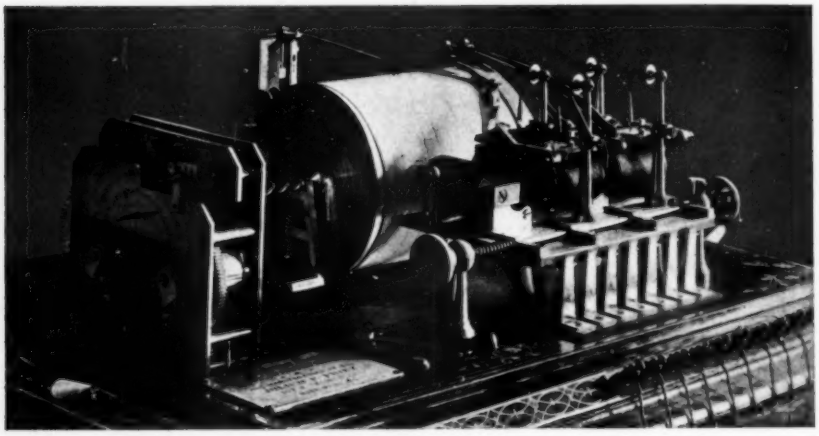

FIG. 9.—THE TRIPLE REGISTER. Rear view.

through a yoke which is turned by the clock, this arrangement permitting the shaft to recede from the clock under the action of the spiral. The cylinder revolves four times in twenty-four hours, so that each record passes across the paper four times.

The wind vane is an arrow-shaped vane mounted on a vertical shaft. The tail of the arrow is gradually broadened laterally to give it greater steadiness. A sleeve is fastened on the shaft

of the wind vane and is provided with four cams, each of which extends over three eighths of the circumference and the central points of which are a quarter of a circle apart. Four contact levers, having rollers in their ends, bear on these cams; and, when raised

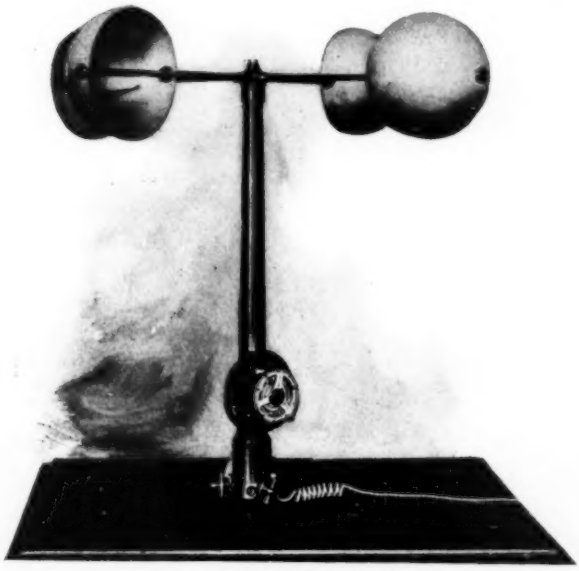

FIG. 10.—THE ANEMOMETER.

by the cams, the levers touch contact springs having a wire from each that runs to one of four magnets beside the "triple register." The levers and magnets are all connected with batteries. The magnets act on armatures that are carried by levers, one for each magnet, which have pens that make a dot on the paper of the cylinder every time the magnet acts. One or two contact levers are always elevated by the cams to make a contact. The cams are so arranged that only one cam acts when the vane is directed to a cardinal point of the compass; but, when it is between two such points, two of the cams are acting. Thus the eight principal directions of the wind are indicated by the four pens. The clock breaks the circuit of the vane except for an instant each minute, so that the pen in action makes a dot each minute.

The velocity of the wind is registered by an instrument consisting of a vertical shaft which carries four horizontal arms having sheet-metal cups on their ends. The wind acts more strongly on the open faces than on the backs of these cups, and causes them to revolve the shaft. Through gearing connected with the shaft, pins on an index close an electric circuit for every mile the wind travels, and the current through a magnet of the triple register causes a sidewise mo-

tion of a pen acting on the paper. The number of jogs in an hour thus made in the line traced by the pen gives the velocity of the wind. The ninth and tenth pins are connected, so that one long jog occurs in the record for every ten miles, making it easy to count the total.

FIG. 11.—THE SUNSHINE RECORDER.

The sunshine recorder is constructed on the principle of the differential thermometer. Inside of a vacuum tube is a tube having a bulb formed on each end, and the inner tube extends into the lower bulb nearly to its bottom. Both bulbs contain air; and the lower one, which is coated with lampblack, has a quantity of mercury in its lower part. The mercury also extends up into the tube. Two wires enter the opposite sides of the inner tube between the bulbs, and these wires form part of the electrical circuit of the one of the magnets of the triple register which magnet occupies a side of the triple register by itself. The armature of the magnet, through a pawl-and-ratchet mechanism, gives the pen lever of this magnet a step-by-step motion, first to one side and then to the other. This action takes place when the sun, shining on the heat-absorbing lampblack, causes the air and mercury in the lower bulb to expand and force the mercury up the inner tube until it completes the electrical circuit between the wires in the inner tube. The clock breaks the

circuit except for an instant each minute. When it is cloudy the pen simply traces a straight line.

The recording rain gauge consists of a cylindrical casing supporting an open funnel above and a reservoir below. Beneath the mouth of the funnel is a pivoted tray or "bucket" divided into two compartments and pivoted so that it can be tipped to bring one compartment under the funnel mouth; and, when that is filled with rain water, it will be overbalanced and tip down, thus pouring its water into the reservoir and bringing the empty compartment under the mouth of the funnel. This tipping of the bucket momentarily closes an electrical circuit including the sunshine-recording magnet of the triple register, and causes the pen to follow a motion in general like the sunshine record, but so irregular as to time, and having either more or less steps in a given time according to the rapidity of the rainfall, that it is easily distinguished from the sunshine record. The clock does not interfere with the circuit of the rain gauge.

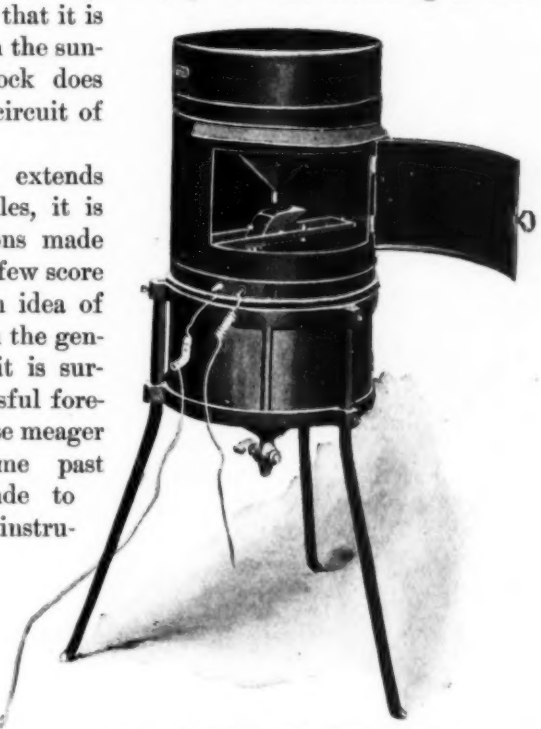

FIG. 12.—THE RECORDING RAIN GAUGE.

As the atmosphere extends upward some forty miles, it is evident that observations made at the usual height of a few score feet can not give much idea of the condition existing in the general mass of air, and it is surprising that such successful forecasts are made from these meager data. For some time past efforts have been made to carry up recording instruments by means of kites or trains of kites. The kite shown in Fig. 14 is a typical Weather Bureau kite. Its weight is but six pounds, and yet it presents to the wind an area of fifty square feet, and has lifted a weight of one hundred pounds in a wind of twenty-five miles an hour. An altitude of seven thousand feet has been reached with the kites. A special instrument is made for attachment to the kites that electrically records the temperature, pressure, and humidity of the air and the direction of the wind. The combined weight of the instrument and

battery is but two pounds and a half. When it is considered that, owing to the weight of the air above, the bulk of the air is comparatively near the surface of the earth, it will be seen how very valuable are observations made at the heights reached by these kites.

It may well be asked: Of what practical value are the Weather Bureau reports and prophecies? As a matter of dollars and cents, does the expenditure of the money necessary to support the Weather Bureau pay? Upon investigation it will be found that it is an immensely profitable investment.

Reports are received weekly from eight thousand special correspondents concerning the effects of the weather on the crops, and these reports serve to set a value on the products which is in just proportion to the supply, and to enable plans and contracts for the future to be made with reasonable certainty.

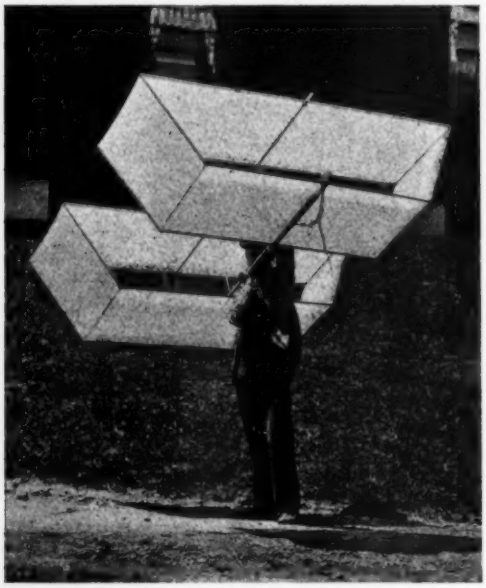

Fig. 13.—A Weather-Bureau Kite.

The records, running back as they do for many years, enable invalids, manufacturers, and agriculturists to find with certainty the locality that is best suited to their needs. The investigations of the Weather Bureau have been directed toward determining the parts of the Unites States where the most constantly humid atmosphere may be found in order that cotton manufacturers may know where their spinning can be most successfully done. Forewarnings of frost enable the truck farmers to protect their produce with a mantle of smoke from a smoldering fire.

The terrible cyclones of the West are frequently foreshadowed by the Weather Bureau long enough in advance to enable people to place themselves and their property in the most protected conditions; and, during the floods of the Mississippi and Missouri Valleys, incalculable savings of life and property result from their warnings. Before the days of the bureau the West Indian hurricanes came unannounced, and sometimes two thousand lives were lost in a single storm. Under the warnings of the Weather Bureau, three such

storms have passed in succession without the loss of a single life, and the property saved from one storm in the form of vessels detained

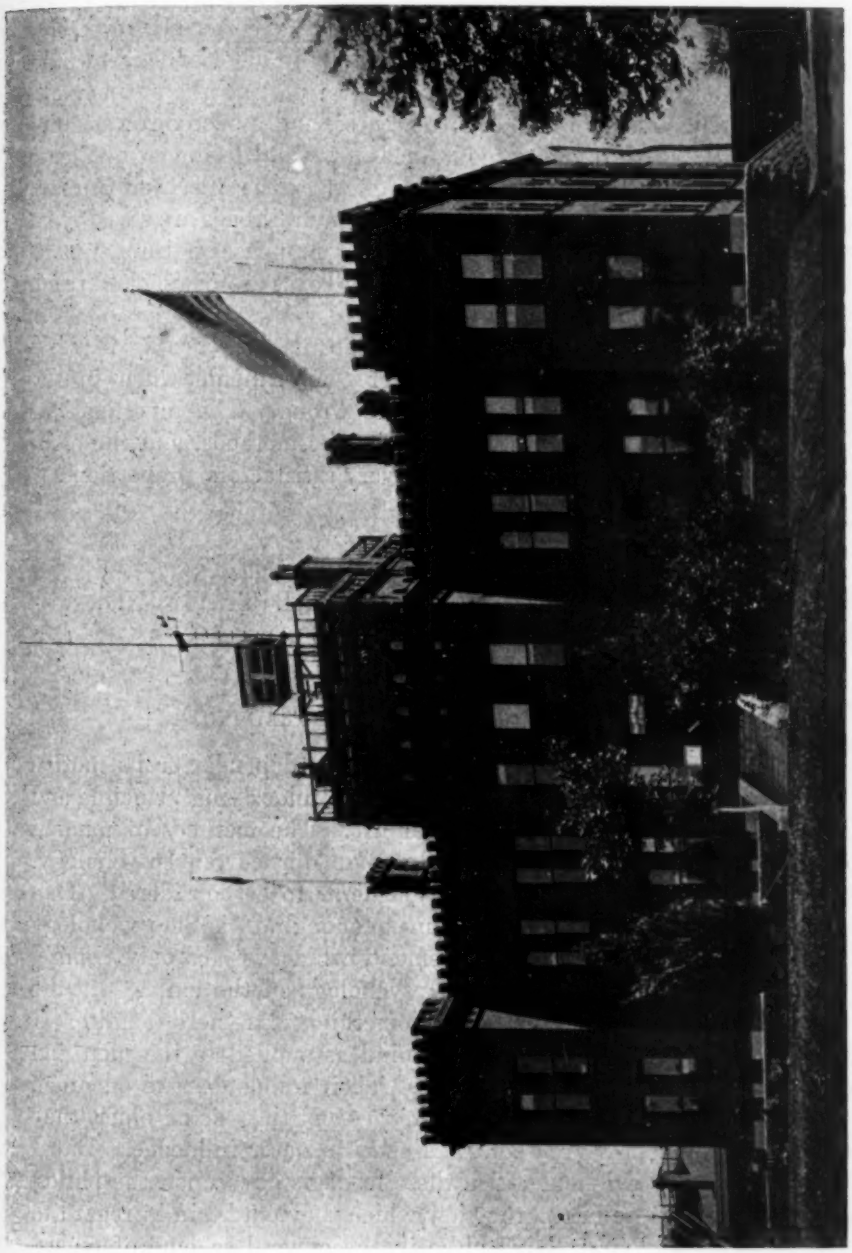

FIG. 14.—THE OFFICES OF THE UNITED STATES WEATHER BUREAU.

in port would support the service for two years. At Buffalo, in the winter of 1895–'96, by forecasting six very severe storms, one hun-

dred and fifty vessels, valued at seventeen million dollars and carrying eighteen hundred persons, were held in port by the warnings. Every one remembers how the American liner St. Paul went ashore near Long Branch, February 2, 1896. A dispatch from the forecaster informed the captain that at such an hour the wind and tide would present the most favorable opportunity for getting the steamer off. At that time everything was in readiness, and a successful attempt was made. A ship and cargo valued at several millions of dollars were thus saved largely through the effort of the Weather Bureau.

By predictions of the heavy snows, many railroads are saved from complete and lasting blockade, and the immense cattle herds of Kansas, Nebraska, Indian Territory, and Texas are enabled to reach places of safety.

The Weather Bureau not only justifies its existence by its services, but it deserves sympathy rather than ridicule when in the face of such difficulties its forcasts are wrong. The investigations of its scientists are constantly improving its methods, and the error in its predictions is being reduced to very satisfactory proportions.

THE PHILOSOPHY OF MANUAL TRAINING.

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II.—THE METHODS OF MANUAL TRAINING

THE general project of manual training depends for its motive upon our scheme of ethics, and for its underlying principle and justification upon our philosophy of life. The methods of manual training depend no less completely upon our current psychology. But in this there are two distinct elements to be considered. One element, which I think we do not make enough of, is the psychology of the teacher; and the other element, which we are only coming slowly to make enough of, is the psychology of the child. By the psychology of the teacher I mean something extremely definite. I do not mean the general laws of mind as applied to the men and women who teach manual training. Their minds operate on much the same principle as do the children's, except that, being older, they are naturally less flexible and less open to outer influence. But I mean especially the hold which these teachers have upon the philosophy of manual training; the view which they entertain in regard to its function and its relative place in the general scheme of education; and, finally, their own intellectual and emotional and bodily culture.

Some one, I believe, has been pleased to calculate that the efficiency of school work depends upon the equipment to the extent of only fifteen per cent, and upon the *personnel* of the teaching force to the extent of eighty-five per cent. You remember, perhaps, what was said of Mark Hopkins: Put Mark Hopkins on one end of a plank, and a boy on the other end, and you have a university. I do not think these estimates are exaggerated. It is the human element that counts.

The bulk of our secondary education in America is carried on in the public schools, and there is much to be said in favor of this arrangement, and somewhat to be said against it. The fortunes of these schools are for the most part in the hands of boards of education, which are composed mainly of prominent and successful business men—men with a large turn for affairs, and scant patience with the theorizing of philosophers. It is noteworthy that the class of problems with which these men have principally to deal in their private affairs are concerned with material ends, and it is only natural that, when they come to turn their hands to public affairs, the material aspect of things should most claim their attention and energy. I say that it is only natural. It is none the less unfortunate.

Now, the *personnel* of the teaching force is just one of those immaterial problems with which these popular committees are both by training and disposition least prepared to deal. It constitutes, I think, a particular weakness in public education, and one that we can only overcome by taking the practical conduct of education more and more out of the hands of those admirable citizens whom we may call the friends of education, and putting the matter more and more into the hands of men and women specially trained for this most important service.

When you come to the carrying out of a special scheme of education, such as manual training, you will readily see that its methods necessarily depend very largely upon teacher psychology, and I propose to devote the first part of this paper, which has to do with the methods of manual training, to an examination of the attitude of mind which the teacher of manual training brings to his work.

There are, of course, as many views of manual training as there are people thinking about it, but in a broad way there are two very distinct and I may say somewhat antagonistic views. These are not, however, views which men and women have looked upon and deliberately elected. They are much more organic than that. They are views which have grown out of their daily living, and represent their unconscious attitude toward life itself. This genesis gives them both the respectability that is inherent in all honest opinion, and also the fixity that is the most hopeless quality in prejudice. I may,

for the sake of a handle, name the two views the educational and the artisan view.

Manual training as a scheme of education occupies a curious middle ground. It has not been evolved in the schools themselves. Like most of our educational innovations, it has been forced upon the schools from without. But the lack of harmony in our conception of manual training does not grow out of this circumstance. Indeed, were it a brand-new thought, offered us from any one of the world's intellectual or industrial camps, we might expect it to present a unit conception, to be accepted, or declined, as the case might be. But such has not been the genesis of the manual training idea. It has not been introduced into education as the embodiment of the educational creed of any one party. It has come into the schools from two different directions, and in its outer form is the incarnation of two distinct and radically different modes of thought. You can hardly understand manual training as a system of education unless you understand its history; and you will readily see that the methods used by the teachers of manual training, while conforming in a general way to one pattern, depend for their essential spirit upon the path by which these teachers have approached the subject. While manual training in some form is a part of all education and appears in all grades, it began its career as a distinct scheme of education in schools of high-school grade. All the early manual training schools were high schools. Even now, when manual training has grown and spread beyond our most sanguine expectations, the typical manual training school is still a high school. Now, the high school occupies a middle ground. It has, on the one side, the elementary school and kindergarten, and, on the other, the college and technical institute. The curriculum of the high school is consequently a composite, and contains elements borrowed from the lower schools and from the universities, or thrust upon it from one of these sources. But as a rule each element in this composite has come into it from one direction, either up or down, and has not assailed it from both sides. Manual training occupies the exceptional position of having come from both directions, from above, from the technical schools, and from below, from the kindergarten and from sloyd, and to have brought from both of these sources fundamental ideas much at variance with each other. In the technical schools manual training is pursued purely as an end in itself and absolutely without thought of its culture value. It is wanted simply as a help to engineering studies. The formal manual training had such an origin. It sprang up in Russia in the technical schools of Moscow, and first attracted any general attention in America at the time of the Centennial Exhibition in 1876. The thought back of it was purely utilitarian. It

was, I believe, quite devoid of any idea of physiological or mental reactions of definite and independent educational value.

This system was seized upon in America by men of the industrial type of mind, and was valued for what I may call its bread-and-butter reaction. While I do not sympathize with their main thought, I do not wish in any way to discredit that part of it which was undoubtedly admirable. These men looked upon the high schools of America and saw that many of them were not educational. They saw that they were commercial, that they were teaching commercial geography, commercial arithmetic, commercial penmanship, commercial bookkeeping, and the like, and that as a result they were turning out a race of clerks with ideas little above those of trade and bargains, who could be had by the thousand in any of our great cities for from five to ten dollars a week—perhaps I ought to say from three dollars a week upward. Meager as is the ideal of life presented by industrialism, it was a great step forward as compared with the commercialism which it is meant to supplant. Viewed from the human standpoint, it is a step forward just in proportion as the thoroughgoing artisan, with his strong, lithe body, his quick eye, his skillful hand, his somewhat independent habit of mind, is better than the thoroughgoing clerk, with his endowment of all that is commonplace and subservient. But the men who introduced manual training into America saw that these commercial young people from the high schools had not deliberately chosen so mean a plan of life, but had rather been forced into it by the absence of any better plan. I do not mean to go into the vexed question of free will and necessity, but I think as students of education that we can not shut our eyes to the fact that the young person we are considering, now midway in his teens, is still the victim of his own inexperience, and is very far from free, and that the older half of society has very obvious duties to this same young person, not only in creating generous ideals of life, but not less in inaugurating a social *régime* which will open the way to their realization. It is quite useless to allow, or perhaps I ought to say force, boys and girls to grow up in the atmosphere of a low social ideal, and then blame them for it. It is quite useless to consent to a social order which presses sadly upon the majority of men, and then despise humanity for not making way against the inevitable.

And the Centennial Exhibition opened the eyes of the nation to another fact. It showed us that despite our boasted Yankee ingenuity, American workmen were far less skillful than their European and particularly their Continental brethren, and the fact had to be accounted for. It was seen that in America manual labor was looked down upon, that the social as well as the educational pressure

was all in the direction of commercialism and away from handicraft, and finally that the boy who braved social opinion and went in for hand work had to do it almost by stealth. The old institution of apprenticeship had died, and the present order of artisan had been so far tainted with the commercial spirit as to be jealous of his skill. He hoarded it like a miser, unwilling to pass it on from generation to generation. The ranks of skilled workmen in America were and are renewed from the more fertile soil of Europe. Furthermore, in 1876, education in America was even more a mechanical process than it is to-day. All these forces conspired to give manual training a distinctly industrial trend. And this trend was manifestly strengthened by the fact that manual training had been originally apprehended as a form of industrial education. It had indeed appeared in the literature under that name, and under that name was being advocated in Switzerland, in France, and in parts of Germany. I do not think that in 1876 manual training was anywhere being put forward as a culture branch. The movement in America began largely as an artisan movement. The schools that were started in the decade following the Centennial Exhibition were all conceived in this spirit. Some of them have experienced no change of heart since then, but others, I am happy to say, have been transformed and transfigured. Like Saul, the son of Kish, we unexpectedly found a kingdom. Later schools have had much the same history. In some the leaven of the new idea has worked; in others not.

But even within the bounds of the artisan spirit, a restraining grace came into play, which illustrates very well, I think, the tendency of education to continue its search for underlying principles, however unfavorable the conditions, and so to substitute the general for the specific. Manual training, even in the hands of these industrialists, never developed into the teaching of specific trades—the manual training schools were always distinct from the trade schools. Whether the industrialists were appalled by the diversity of trades to be taught, or were restrained by some vague notion that the state ought not to foster one craft rather than another, or were frightened by the prospective antagonism of the trades unions, I do not know, but certain it is that the movement gained educationally with each repetition of the assertion that no trades were taught, but only the principles underlying all trades. The growth of this universalizing spirit has made possible a far broader conception of the true function of manual training.

But meanwhile the manual training idea had been making its way into the curriculum from the other direction, from the lower schools, and from them it came purely as an educational idea. The educational conception has come from the kindergarten, from sloyd,

and last of all from a more abstract source, from philosophy. Let us glance at these three elements.

Manual training permeates the whole Froebelian philosophy. Arnold has said that religion is morality touched with emotion. One might characterize the kindergarten as activity touched with sentiment. As far as may be, the activity is all self-directed, for that is the only sort that has any educational value. The hand comes in as the instrument of much of this activity. It is particularly to be noted, however, that the training is quite without industrial import. It has no ulterior purpose, but is simply and solely directed to the development of the child as an organism—an organism whose function is thinking and feeling and acting. The activities of the kindergarten are manifold, but the *motif* is always the same. It is constantly educational. Between the kindergarten and the manual training high school there is a gap of between seven and eight years, the dreary desert of the elementary school, where I sometimes think that children are taught with infinite patience things that they would have found out for themselves next year. But the spirit of the kindergarten has crossed this gap, and has made itself felt in the high school as the educational advocate of manual training. Froebel built true and firm in resting the foundations of the kindergarten upon the self-activity of children, and its *motif*, development, carried into the work of older children, must take some form of manual training. And so manual training came knocking at the doors of the high school, not alone from above, from the technical schools, but from below, from the kindergarten as well, but from this side it was a triple knock.

In the far north, in Sweden, there had been growing up a system of manual training for elementary schools based entirely upon the educational idea. It was not called manual training, but was known as "sloyd," which signifies handy or dexterous. It involves the idea both of planning and executing—that is to say, the idea of creative work—and is a direct and beautiful application of that principle of self-activity which Froebel made the corner stone of the kindergarten. It is permeated with the true Froebelian spirit, and is quite worthy to follow the kindergarten in a rational scheme of education. As the basis of sloyd we have the old peasant hand work, rich both in beauty and in sentiment. This has been systematized into a scheme of regular school work, and has been made purely educational. But it has not lost, I am happy to say, the sincerity and reality that characterized the old peasant handicraft, and I value it so highly, not alone for its true educational spirit, but quite as much for the warm human sentiment that is an essential part of it. Sloyd is very thoroughgoing in its methods. It strives

to develop the body by a series of physical movements physiologically arranged, to develop the mind by means of the rich mental reactions which accompany all motor activities; and not less to develop the heart by enlisting in all the work the child's good will and unselfishness. Sloyd has been well defined by Mr. Gustaf Larsson, the head master of the Sloyd Training School in Boston, as "tool work so arranged and employed as to stimulate and promote vigorous, intelligent self-activity *for a purpose* which the worker recognizes as good." It is a capital definition and a noble aim.

Sloyd constituted the second party in that triple alliance of which I have spoken. But there is still a third element involved, one too recent to have had any history, but destined, I am bound to believe, to do great things and to win the day against the combined forces of industrialism itself. The third element comes from the universities, but approaches the high school along the path of the lower schools, and so allies itself with the kindergarten and sloyd in forcing manual training into secondary education on purely educational grounds. It is nothing less powerful and modern than experimental psychology itself. The study of human physiology, and especially the study of brain action, is showing us each day more and more conclusively that if you want good work you must have a good tool—that is to say, a good organism—and that is precisely the educational basis of all manual training. It is the search for organic power.

These two conflicting ideals of manual training meet and do battle in the manual training schools. If you take a school built up on the educational ideal, and another built up on the industrial ideal, you will find them both doing apparently the same thing, but you can not, I think, get very far beyond the threshold without observing a tremendous difference—a difference that you will remark in many quarters, but nowhere so distinctly as in the faces and persons of the boys themselves. The difference is not due to any variation in the material equipment, perhaps to no great change in the curriculum, but to a very subtle, intangible thing, to the point of view of the head master. It all depends upon him and upon which view of manual training he entertains and would have prevail. I can not too much emphasize this point. Back of all action there is an idea, a motive. If you would change the action, you must first change the idea. It makes a tremendous difference what people are thinking about as they carry on their work. This principle is the basis of all scientific pedagogical effort, of all scientific reform, indeed, of all well-directed work of any kind which has to do with human elements. It is the fault of the old education and of the old schemes of reform, and, for that matter, of too much of current education and current schemes of reform, that they address

themselves solely to the outer event, and leave the motive, the idea back of it all, quite undisturbed. The real pivot upon which the manual training movement swings is in the idea. In presenting manual training to you as a scheme in which two opposite and antagonistic ideals are now contending for the mastery, I do but state the fact. But I have large faith that the educational ideal will ultimately prevail, and this in spite of the fact that the schools themselves—that is, the manual training schools proper—are largely in the hands of the industrialists, and avowedly represent the artisan point of view. I have tried to do full justice to that point of view, and I want to say again that as a substitute for the commercial training of the average high school, with its bookkeeping, and commercial arithmetic and commercial geography, and commercial ideas of life generally, even the artisan training is a marked advance. It is to be welcomed by all who value a more sturdy living and who esteem power. As a man, the decent artisan is infinitely ahead of the smug shopkeeper. Furthermore, the same artisan point of view, by cultivating self-reliance, by spreading self-supporting ideas of life, by imparting useful skill, by encouraging self-activity, does render a large social service, and does, quite unconsciously, possess a large educational power. I should be unwilling in any way to belittle this service. It is something to be socially grateful for, and to be appreciated at its full value. But the criticism remains true that what is not the best is bad, and the artisan point of view, not being the best, I must maintain is relatively bad.

Many of the training schools represent this artisan view, and one need never go far afield to find striking examples. In my own city of Philadelphia, which I believe is chiefly known in New England for the excellence of her butter and the whiteness of her doorsteps, there are two manual training schools, in which from the very start the educational purpose has been bravely upheld. The two ideals have been in conflict there as elsewhere, for we are a thrifty city with some talent for turning an honest penny, in spite of our love of comfort and grandfathers, but the fight has been a good one, and in the main a successful one.

It is always more effective to paint in black and white than it is in neutral tones, but in presenting these two views of manual training as so sharply distinct, I have not been bent, I think, by artistic motives. I believe the two views to be as sharply distinct as I have painted them.

Assuming, then, the educational point of view on the part of the teacher, we may turn to the second element, the psychology of the child, as our monistic philosophy sees it, and may inquire into the methods which that psychology suggests.

First and last and always, the problem is human. Manual training has but the one purpose, the development of the child, and it can only carry out this purpose by learning how the child develops. Every organism—and manual training, as we have seen, considers the child to be a unit organism—is in contact with an outer world, with something which is not self. This contact produces sensations. We can not know the outer world, can not know whether indeed there be an outer world. We can only know our sensations and the stream of thought into which they merge. As soon as we begin to think, we are forced into some stage of idealism, but whether we take the moderate, in a sense realistic, ground, that there is an outer world, but that we have no knowledge of it except as a mental experience; or the middle ground, that there may or may not be an outer world, that we have no warrant for either affirming or denying its existence, but that the one undeniable reality is consciousness; or the extreme ground, that there is no outer world at all, but that the drama of life is a drama carried out simply and solely in consciousness, it makes, happily, little difference in the practical methods of education, provided we do not vivisect the child, and get something out of him other than a unit. What we have to deal with in any case is human consciousness, and our work is to unfold and perfect that.

These sensations, whatever their origin and precise nature, are certainly the primary material of thought. Knowledge is a perception of relations. The process of thinking is a process by which we bring our sensations into relation with one another, or bring a sensation into relation with some concept, which is the abstract of a previous group of related sensations, or bring one concept into relation with another. Knowledge, then, is the result of thinking, and it is only by thinking that we can grow wise. Experience being the best teacher, it is commonly stated that knowledge is the result of experience. But this is not strictly true. It is only true when you specify what sort of experience you mean. If the experience has resulted in an embarrassing wealth of sensations, and has created little disposition to bring these sensations into relation with one another, the product is not knowledge. Globe trotters are not proverbially wise people. But if the experience has taken an inner turn, and has consisted in a careful and luminous working up of the crude materials of consciousness, the product is knowledge of the highest sort. This accounts, I think, for the fact that some of our most profound philosophers have been men of somewhat limited experience. But there are cautions in both directions. If the omnivorous reader and globe trotter stand at one extreme, no less does the closet philosopher, building tremendous structures out of

insufficient material, stand at the other. Health is found in the golden mean—to meet life and to reflect upon it. I take education and evolution to be one, the reaction of the environment upon the organism. The process consists in arousing in consciousness a group of sensations of the right sort, and in the right amount, and in inducing a habit of working up this material into thought. The process requires a wholesome organism, and one operating in obedience to some inner impulse—that is to say, it requires self-activity and not vicarious activity. It is a very subtle process, work for angels rather than for men, and all the while it must be carried out with utter unconsciousness on the part of the child as the result of his own spontaneity. The teacher may stimulate this self-activity, must supply materials for it to spend itself upon, but never—and this is the particular temptation in the path of the teacher—never must he substitute his own activity or his own impulse. It was a great day for me when I woke to the fact that one can only do what one wants to do. It was a great day for me, both because it taught me the source of my own actions, and because it taught me that to influence other people's actions you must first influence their desires. A given environment is not the same environment to two different children. Their power to respond is different. Their will to respond is unequal. If the environment is to react helpfully on both of them, either a change must be brought about in the children themselves, by means of a secondary or preliminary environment designed especially for that purpose, or else the given environment must present alternative elements calculated to appeal to different natures. Both methods are legitimate and both are often necessary. The first is brought about by the personal *tête-à-tête* work of the teacher, work wholly individual, work requiring the characteristics of both the serpent and the dove; and the second, by giving the school life that flexibility and many-sided interest which will allow some choice on the part of the child. The sensations that we want are only brought about by action, by direct physical contact with the environment, and this can only come as the result of desire. We live in a world rich in possible activities and sensations, embarrassingly rich, but possible only to those who want them. One can only do what one wants to do. The source of power and the limitation of power are one. It is found in the emotional life, in desire. Where this is manifold and rich, life is manifold and rich; where this is stunted and poor, life itself is stunted and poor. There is here a direct causal chain which can not be broken, and which must be taken into account in any rational educational method. It is desire, action, sensation, thought. I do not know whether psychological analysis will some time show us what desire is, or separate it into more primal

elements, but, however composite it may turn out to be, it will always continue the mainspring of human action, and the primary element with which education will have to deal. Everything centers in the emotional life. To stunt and cripple and repress that is to make impossible a full life in other directions. Kill it, and you have the dead souls of our social world. In childhood, the emotional life is strong. And here, I think, and not in Florida, is to be found the fountain of perpetual youth. We should never grow old if in our hearts we could keep always the full flood of feeling. It is the drying up of this part of our natures that makes possible the dreadful indifference and paralysis of old age. And we want this prodigality of feeling because it will lead to action, and we want action because it will bring sensation, and we want sensations because they are the material of thought. Manual training builds its methods upon this psychology. It looks first and last and always to the motive power, to the emotions and desires. If these are strong, if the child is alert and full-blooded and interested, at once may be undertaken the more specific work of supplying a rich and suitable environment, to keep alive this emotional life, to strengthen it and to direct it to helpful and noble ends. Well-born children possess this full emotional life, but with apathetic children it must be aroused. The little childish heart must be set on fire with new desires and longings, and these made so strong that they simply must be satisfied. This is a difficult task, and one with which the older schemes of education do not pretend to cope, for they do not realize that it is an essential part of their work. Indeed, for the most part they address themselves to the very contrary proceeding, the repression of such childish desires as already exist and are found not to be convenient.

The method by which manual training arouses and fosters a many-sided interest and stimulates desire is by giving children something to do, and by allowing such a free play of choice and individuality both in the something and in the doing that at the very first possible moment the activity shall be self-directed. When this point is once gained, the work of education has begun. Where the will is weak, as in the case of poor, anæmic children, the interest may soon flag, may indeed sputter and go quite out. And all this is very discouraging. But the interest must simply be aroused and stimulated afresh. Never, however great the seeming extremity, must the interest and desire of the teacher be made to do duty for that of the child, for, the moment this occurs, the work of education ceases, and a meaningless, unpsychological process takes its place.

It is not much learning that makes us mad, but much interference.

In young children, the great impulse is to play, and it was this

form of self-activity that Froebel seized upon. But the desire to make things, the constructive faculty, is also there, and this is utilized in the weaving and other forms of paper work. In older children the play impulse weakens and the constructive impulse strengthens. It is this latter impulse that manual training appeals to. In doing this there is large choice of method. But the essential element is always the motive power, the desire. This bears the same relation to all that follows that the water or steam power does to the mill. It keeps it running.

The formal manual training does not concern itself specifically with the principle of interest. It lays out a series of abstract exercises, involving the primary tool operations in wood and metal. The exercises are as abstract as the propositions of geometry. They are carefully graded so as to be increasingly difficult, and are all dimensioned. Thus in wood, the first year's work may consist in a series of from seventeen to twenty-one exercises, beginning with a simple rectangular parallelopipedon, and ending with a somewhat elaborate dovetailed box. In the second year the joinery course gives place to pattern making, the creation of forms which are to be used as molding patterns in casting in lead and iron. Here, too, the exercises are carefully graded, beginning with simple forms and ending with quite difficult problems. The sequence differs in different schools, and no two schools use precisely the same exercises. But this is a detail which is not essential to the method. There are usually three terms a year—terms of about thirteen weeks each—and as the wood work runs for two years in the typical three-year manual training school, this gives six terms in all for the accomplishment of the instruction in wood. It is customary to devote one term to wood carving, and another term to wood turning. This latter is sometimes introduced during the first year, if there are enough turning lathes for all the boys to work at once, and sometimes it is given as a secondary course, running along with the joinery and pattern making.

The same principles hold in the metal working. It is all carefully graded. During the first two years it includes the primary operations of the machine shop and the blacksmith shop—chipping, filing, and fitting; molding and casting; forging and welding, ornamental ironwork and tinsmithing. During the third year the manual work, exclusive of the science laboratories and the drawing rooms, is usually confined to machine-tool practice, and here the time is divided between abstract exercises and finished projects.

The course is entirely logical. It was originally planned for the one purpose of imparting technical skill, and it does this in a large and surprising manner. It seems incredible that some of the work turned out could have been done by young boys. Nor do the boys

have to be urged to this work. Although the object is simply technical skill, and does not concern itself primarily with human motives, still the work is so thoroughly in line with boyish activity that it does quite unconsciously enlist those desires to a very large extent. You can see this if you will watch the little workers. They are for the most part absolutely absorbed, and quite unconscious of your own presence. There is in all of us a strong desire to excel, a delight in overcoming obstacles. We like to do battle, and especially when we are young. A cross-grained piece of wood, a stubborn bit of metal, are so many challenges, and an alert boy is eager to accept the gauntlet. Some of the boys, furthermore, have conceived the idea that they would like to be carpenters, or pattern makers, or wood carvers, or machinists, and work under the spur of an ulterior purpose. At fourteen they have already begun to live in the future, and have accepted the ideals of industrialism. The organic reactions that follow upon this manual activity, though not so good as would follow from a more psychological course, make, nevertheless, for increase of brain power. There is a notable enlargement of judgment, of accuracy, and of self-reliance. There is an actual increase of physical health, there is a usable skill. And all of this is very good. But these results, splendid as they are, can be made still better, and are being made still better by the humanizing of the whole scheme in the hands of educational workers. The spirit of the kindergarten, the spirit of Herbart, the spirit of sloyd—a spirit which finds no scheme of education tolerable which has not for its object the full and complete life, the life of body, of intellect, and of heart—this spirit, I say, has been permeating our thought and making its way into the high school. And this is precisely what the formal, technical manual training most needs. It needs to be humanized. It wants to be touched with morality, with beauty, with sentiment, in order to be the ideal education; for the end of education, as Herbart has well said, is to create in the child a moral and æsthetic revelation of the universe. I have confidence that this humanizing spirit will conquer, and that manual training will ultimately mean in all our schools what it means to-day in a few of them, and is coming to mean in many more—a complete, human, educational process and not simply an artisan training.

The methods of this educational manual training concern themselves very much with the principle of interest. They seek not only to satisfy existing desires, but to create new ones. Theirs, you see, is far from being a doctrine of parsimony. It is rather a doctrine of ungrudgingness. In place, therefore, of abstract exercises, poor in present human interest, finished articles are offered. They are very simple, of course, but they are as carefully arranged and graded

as the abstractions they replace. Groups also take the place of single articles, so that the boy may select his work, and so have the advantage of a deeper and more individual interest. In addition, the principle of service is brought in. The articles are useful—some little domestic convenience that may be given to the mother, some well-made trifle that the father will use and value. The sentiment which is thus woven into the work is far from idle. It is more than a pretty nothing. Have you ever reflected that all the great and beautiful things that have been made and done in the world—the great pictures, symphonies, poems, stories, buildings, exploits of all kinds that have needed the human spirit—have been made and done, not as the result of technical skill, but as the result of a sentiment, the sentiment of hope and love? I regret the partial decay of a visible religion in our midst, not because I believe that men need creeds to make them good on earth or to point out the way to heaven, but because it seems to me that an impressive worship, rich in color, in music, and in tradition, does so much to keep alive the sentiment of man, and give him the power of great and noble performance. I can not but envy the old painter who brought to his work the passion of a divine and human love, who painted the Mother of God with that face which embodied his own heaven. It may be that that passion for humanity which is appearing now as a redeeming force in modern society may some time touch afresh the national life with emotion, and open to us again a period of great performance.

The Herbartians are right, I think, in their scheme for the correlation of studies, when they group all the work about some sentiment study and invest all with human interest.

There is, further, an æsthetic objection to the abstract exercises of the Russian manual training. They are not beautiful. The finished projects of the American system—for so I shall in hope call the educational manual training—may be made beautiful. This, again, is a principle in both kindergarten and sloyd work, and one that we can not leave out of the count. It is, I think, an educational crime to have children deliberately make ugly things. Why should they, when there is so much possible beauty in the world, and so much real ugliness already? It is of large importance that children in all their work should regard beauty as a sacred and necessary quality.

The finished projects have a further advantage in better allowing a large proportion of free-hand work. Curved lines and warped surfaces that can only be judged by sight and touch are not only more beautiful but also more educative. A too great reliance upon calipers makes us all mechanical. It is quite possible to have the

projects accurate and fully dimensioned, and yet largely free-hand. To fulfill all these requirements—to have the work proceed strictly as a result of the self-activity of the child, to invest it with an emotional interest, to make it sound physiologically and æsthetically—is not easy, and much ingenuity is required and will be required to work out a satisfactory set of models. It is just as important to have them carefully graded. It will never do to discourage the child by too great initial difficulties, nor to waste time by adding difficulties too slowly. There must be constant progress. When a bean stalk gets to be ten inches high, the next thing for it to do is to get to be eleven inches. And not only do the projects vary, but the materials as well. Wood and metal and clay, even leather and fabrics, all lend themselves to the purpose and are all utilized. If this work is to create that many-sided interest in life of which we have been speaking, it must have many sides to it. The projects, then, ought to have diversified social functions. The first interests of the child are all domestic, and it is entirely fitting that the first articles he makes should be borrowed from that aspect of life. But these interests want to broaden. With increased constructive skill, they may well take in more ambitious projects in both arts and science—steam engines, dynamos, cameras, scientific apparatus of all kinds, architectural units, and all the diversified objects of a rich and varied social life. This is in part the practice in the present manual training schools, as far as the third year's work is concerned. The graduating class makes one or more finished projects of a practical kind, sometimes in miniature, often of full size, so that the article may take its place in the equipment of the school. And I am glad to say that more and more the tendency is to substitute these projects for the less fruitful abstractions, and so to realize the educational ideal. Mr. Sayre, the principal of the Central School in Philadelphia, told me the other day that such was the tendency there. It was also the tendency at the Northeast School. Mr. Richards, of the Pratt Institute in Brooklyn, writes me that not only are they substituting simple finished pieces for the abstract exercises, but also that they are giving the preference to small individual projects over larger ones requiring group work, and that they are making these changes because they believe that in this way they develop greater individuality and arouse a keener interest. Dr. Belfield, the director of the Chicago Manual Training School, writes practically the same thing, and adds that they will probably make no more large pieces, except where they are needed in the equipment of the school, work quite justified by the altruism which it fosters. It would be easy to multiply testimony, but I think we should gain nothing by it. The point I want to make is that manual training in America, in spite of our

potent industrialism, is becoming each year more educational, and this is most encouraging.

To stimulate this many-sided interest, and to cultivate genuine sentiment and æsthetic appreciation, are large elements in the method of manual training, but it shares this with other schemes of education. The part of its method which is distinctive is physiological. It is the cultivation of the brain through the body, and more especially the cultivation of the brain through the activities of the hand, the setting up of definite mental reactions as the result of definite muscular movements. Experiment shows that the brain does not act as a whole in its reactions with the outer world, but that for the various activities of life there are specialized local brain centers. Furthermore, function is shown to be directly dependent upon organ. If the organ be impaired, the function is crippled. If the brain center be destroyed, the function is annihilated. The reverse is also true—the inhibition of the function, and the organ atrophies. The exercise of the function means the health and growth of the corresponding center. The localization of brain function is one of the most interesting results of modern experimental psychology, and is well worth the attention of all interested in social movements. If these local brain centers could be stimulated and developed by increased contact of their tributary extremities with the outer world, we should have a strengthening of the brain tissue, a more sensitive organism, and, as a final result, a general increase of intellectual power. The most complete power would come from the most perfect development of all the parts. We want no repression, no thwarting, no deadening. We want the expansion of all the parts by the wholesome exercise of all the functions. And this expansion must go on *pari passu*, not the abnormal growth of one center through the undue exercise of its corresponding function, with the starving of surrounding centers and functions, but the normal and wholesome growth of all. As the hand is the chief instrument of touch, its exercise will cultivate the tactile and visual centers. By the skillful framing of these manual activities, and their arrangement in due sequence, we shall bring about a corresponding series of mental reactions of the highest evolutionary and educational value. Manual training means hand training; sloyd means skill; but the hand training is in reality the training of that part of the brain which directs the hand, and skill is in reality a mental quality. One's cleverness in arranging the manual work comes in right here. It is not in securing a series of mental reactions, for they would come willy-nilly, but it is in securing a series of mental reactions of the most desirable sort.

The term manual work is often used very loosely to include all

forms of mere bodily work, such as the activities of the day laborer, of the washerwoman, and the domestic servant. But such work is not hand work. It is strictly bodily work, and the hand serves merely as the clutch by which the particular tool, whether shovel or broom, is fastened to the body. The main mental reaction is fatigue. But manual work proper is the sense of touch applied to the carrying out of some definite and intelligent purpose.

We do not yet know enough of these mental reactions to reach any finality in the matter of the manual exercises. It is for the present experimental. In the most progressive schools you will find a large amount of flexibility. The exercises of one year will not be the exercises of the next. There is the constant hope of something that will yield richer returns. But the underlying principle is the same. It is distinctly physiological, a system of brain gymnastics by which an expansion of function brings about the development of the organ. It is founded upon a monistic philosophy of life—a belief that man with all his diversity of need and of power is essentially one, a unit organism.

The mental reactions that manual training brings about are essentially ethical, and, since conduct has to do so largely with one's relations with one's fellows, they are also essentially social. The most evolved conduct, that which displays the most complete adaptation of means to ends, can be the result only of a completely rounded intelligence. Complete morality means the setting up of definite moral ends, and it also means their attainment. We weaken the moral fiber deplorably, it seems to me, in our modern way of looking at things, when we lay such moral and legal stress upon the motive, and so little upon the performance. The emphasis is not justifiable. Since motive and act stand in the direct relation of cause and effect, it may be charitable but it is certainly not scientific to couple a good motive with a bad act. If the moral ends have been clearly seen, if that vision of the complete life has been fairly grasped, the more difficult and it seems to me the essential part of morality, the attainment of the complete life, still remains to be fulfilled. To accomplish this part of its mission, manual training seeks to make very clear the relation between cause and effect, and to eliminate the capricious and grotesque. Every bit of manual work is a practical adjusting of means to ends, an object lesson in causation, and when finished, it stands there before us, and tells us in very plain and unequivocal language whether the thing has been well done or ill. There is no room here for idle excuses.

These are some of the methods of manual training. Not one of them is sacred or fixed or unalterable. They are mere tools, a process, a means to an end, something to be altered, relinquished, sup-

planted, as a wide knowledge and a deeper love show such changes to be wise. But every detail of method has the one purpose, and this never changes—the unfolding and the perfecting of human nature. It is the search for human power through the perfecting of the human organism.

WOODPECKERS AND THEIR WAYS.

By WILLIAM EVERETT CRAM.

WOODPECKERS as a class form one of the most striking and easily distinguished groups of birds, the entire family conforming to a certain type to a remarkable degree. Probably each of the three hundred species could be safely described as a vigorous, muscular, heavy-bodied bird, with long wings, close-fitting plumage, and a strong, stiletto-shaped beak. Their legs and feet, like those of the parrots, cuckoos, etc., formerly placed in the same order, are short and stout, with the outer toe turned backward parallel with the hind toe as an aid in climbing. In certain species, however, this outer toe is entirely wanting.

Their peculiar method of gaining a livelihood has developed a tongue perfectly adapted to their requirements; it is pointed and barbed at the tip for securing the larger insects, and is kept constantly coated with a mucous substance to which the smaller ones adhere. At the back of the mouth it divides, and passing each side of the neck at the base of the skull is carried up over the top of the head, where the two portions join and are inserted in the right nostril. In the common hairy woodpecker, and possibly some others, it curves downward, and is wound about the bony case which protects the right eye, the latter projecting more than the left for its accommodation. This double bow enables the bird to shoot forward and contract the barbed tip with wonderful velocity, while the mucus is applied each time from two large glands at each side of the throat.

In the autumn, when the last generation of aphides spreads itself over every leaf and twig in the forest, woodpeckers may frequently be seen engaged to all appearances in licking up these diminutive insects from their resting places, their long tongues giving them a decided advantage over other birds in this pursuit, for woodpeckers are not the only birds that find aphides palatable in spite of their small size—not only the warblers, but purple finches and others, generally supposed to be fruit-eaters, apparently depending to a certain extent on this delicate fare.

The family colors are black and white and red in sharply contrasting patterns, though some members of the group that have

taken to gathering a portion of their food on the ground appear to have adopted the more inconspicuous browns and greens for protection. The common golden-winged woodpecker is a case in point, a bird which I fancy occupies much the same place in this country that the green woodpecker does in England, though the latter is probably nowhere as abundant or familiar as our species. Both are

GOLDEN-WINGED WOODPECKER.

genuine enough woodpeckers, but without the conservative habits of the majority of their race. The typical woodpecker, large or small, spends the greater part of its time clinging to the bark of a tree, by preference a dead one, hitching himself along by short stages, usually ascending the tree by a spiral course in order to survey as much of its surface as possible, and whenever he suspects the presence of an insect beneath the bark his sharp bill enables him to dig through bark, sapwood, and everything, until his victim is finally cornered at the extremity of its hole, and is drawn forth impaled on the barbed point of the bird's tongue, or held fast by the sticky substance which covers it. And while so engaged the bird's black-and-white plumage is really not so conspicuous as might be expected, at a distance the colors appearing to blend in such a manner as to give the effect of dark gray or ash color, which matches admirably with the surface of the majority of tree trunks, especially in the shadow. But the flicker gets a comparatively small portion of its food in this manner. Sometimes, it is true, he may be seen pecking away busily enough on a prostrate log or decaying stump in the pastures, and he is said to render valuable assistance to the fruit growers by digging out the borers from the trunks of peach and plum trees at every opportunity, but he prefers the less laborious process of gathering his insect food from the surface of the ground like other birds, probably digging some of it from the turf with his bill. It is said

that in some parts of the country they have learned the trick of flattening themselves as traps on top of ant hills with extended tongue which the ants seize upon as something eatable and are drawn in and devoured by the dozen.

Now, it would hardly be safe for a woodpecker of almost any other species with black-and-white plumage to follow any such accupation, but the flicker when at rest only shows a subdued brown banded with black, tiger fashion, in a way that might possibly suggest the shadows of grass stems on dry turf or the fallen branch of a tree, the general effect being not unlike that of the plumage of the meadow lark in a similar position. Many of the concealed feathers, however, exhibit the brilliant black-and-white pattern characteristic of the tribe, and when the bird takes flight, as if aware that concealment was no longer possible, he flashes out the full glory of his wings and tail, that, together with the patch of white on his back, hidden until now by his folded wings, make him conspicuous as long as he is in sight. The scarlet of his crest, although bright enough, would hardly attract attention at any distance.

Now, in Kansas and westward the flickers have wings and tail lined with red instead of yellow, and where the two species come together it is said to be not uncommon to find specimens with one wing lined with red and the other with gold, and the tail feathers divided in a corresponding manner.

The green woodpecker of England, as might be expected in a climate where the leaves and grass are not burned brown at midsummer, wears Lincoln green like the foresters of old, who probably

Downy Woodpecker.

knew him well and respected him as a bird that, like themselves, refused to live in confinement, and was only contented when in the greenwood.

Like the flicker, it has received a dozen or twenty common names by which it is known among the country folk, and among them highhole, yaffle, and woodwall at least are common to both this bird and our own species, which appears to have been confounded with the other by the early settlers. Woodwall I have never known to be applied to our bird outside of a certain limited district in southern

New Hampshire, where it is almost exclusively known by that name. He is evidently a bird of a good deal of intelligence, though undeniably cranky at times. He is quick to know where he is not molested, and, once he has convinced himself that the surroundings are not likely to prove dangerous, will take up his abode perhaps in an apple tree a few yards from the house, and will return summer after summer as long as he is allowed to remain in possession. For the last ten or fifteen years, perhaps longer, a pair have nested in this manner in an apple tree on the farm where I write, and have succeeded in bringing up a promising brood each season without serious mishap. When the tree they formerly occupied was cut down, they merely moved to another still nearer the house, and made their hole in a large branch hardly a dozen feet from the ground. They were obliged to cut through the green sapwood at first, and then through a few inches of dry but extremely hard wood beneath, before reaching the decayed heart of the branch, but their bills were equal to the task, and they soon had a gourd-shaped cavern some eighteen inches in depth, with the doorway opening to the south. They seldom exhibit much impatience about going to housekeeping each spring, and it is usually pretty well along in May before they have done their spring house-cleaning. This consists merely in clearing out the bottom of the hole and perhaps enlarging it slightly. There is nothing that really deserves the name of nest, the eggs being laid on the rotten wood or loose chips at the bottom, after the manner of the woodpeckers.

THREE-TOED WOODPECKER.

The birds are rather quiet, but not at all timid during the nesting season, coming and going at all hours of the day, quite regardless as to whether any one is watching them or not. But soon after the eggs are hatched there may be heard a low murmur issuing from the opening of the nest, which increases in loudness day by day until it is a murmur no longer, but a kind of stifled crying and squalling, which rises to a chorus of shrieks on the arrival of the old birds, or, in

fact, at the approach of any one or anything, the youngsters taking it for granted that any sound that reaches them in their seclusion must necessarily mean food, and each endeavors to drown the clamor of all the others.

After a while the parents try to entice them out into the daylight by clinging to the branch and holding some delicate morsel before the entrance, whereupon the most enterprising, or possibly the hungriest, youngster scrambles up the wall of the nursery and, thrusting out his head, seizes the food and falls back aghast at his own boldness. They are apt to be slow about leaving the nest, and are generally fully fledged before they finally gather courage to crawl forth and cling to the branches, shrieking hysterically for their parents to come to their rescue. After a day or two of such behavior they grow braver, and learn to accompany their parents about the orchard, and at last away to the pastures, seldom showing themselves about the house after they have fairly learned to fly. Being a heavy-bodied bird, the flicker is only too often regarded as a game bird, though his flesh is, to say the least, tough, and here is where his intelligence becomes most apparent, for it certainly looks as though these birds learned to know at sight those persons who are in the way of shooting them, for they are almost invariably regarded by these gunners as about the most difficult birds to approach in existence, though others do not regard them in that light, and for my own part I certainly have hundreds of opportunities for shooting them every season if I were so inclined.

YELLOW-BELLIED WOODPECKER.

The downy woodpecker perhaps comes next to the flicker in abundance, for, although never to be seen in any great numbers, one or two of them may usually be found wherever there are decaying trees for them to work upon. Nor do they depend entirely upon dying trees for their nesting grounds, as one may frequently be seen working his way up the stem of a young fruit tree or sapling whose smooth bark would hardly be supposed capable of furnishing concealment for the smallest insect. Next to the apple tree, the elm is perhaps his favorite, the rough bark of large ones allowing

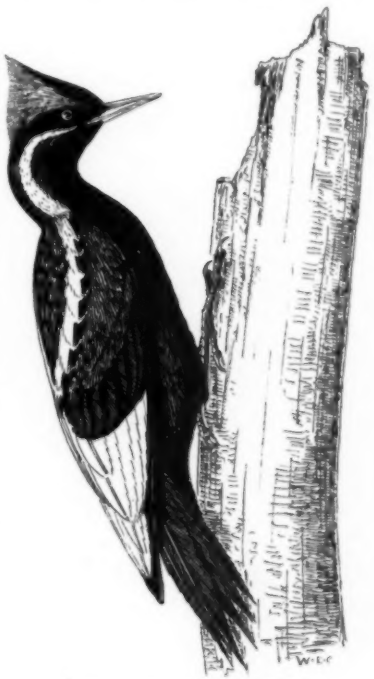
him to move about between the ridges and dig away beneath the loose scales to his heart's content. He is probably capable of spending more time on a single tree than any of the others of his family. After having finished with the trunk he will carefully go over each branch from tip to base, never hurrying, but acting as if he knew that he had the

RED-HEADED WOODPECKER.

whole of eternity to do it in, and perfectly contented to spend half an hour on a space that he could cover with one of his wings. He is usually accompanied by other birds, for birds are not scattered evenly about the woods at any season of the year, but more in company or flocks of half a dozen or a dozen different species, brought together apparently for society's sake, and following any temporary leader from tree to tree.

Downy, however, seldom quits his work when the others see fit to depart, but keeps pegging away by himself until other birds come up, attracted, I fancy, by his rapping, to linger about in his company for a few minutes, and then off again as the whim seizes them. Like the majority of birds, the downy woodpecker is apt to be more in evidence during the spring and fall migration than at other times, but is never entirely absent, and often appears more than usually numerous immediately after a cold wave in midwinter. At this season he sleeps snugly in a hole cut out of the wood for the occasion, and evidently finds the getting up in the morning the most disagreeable part of it, for he seldom shows himself until long after the sun has begun to melt away the frost from the south side of the trees. He is most active now at midday, frequenting southern hillsides, where the air is warmest and the brown leaves show between the drifts, and where he is sure to have the company

of other birds if there are any in the neighborhood. He is not afraid of the cold, however, and may often be seen at sunset hard at work on the exposed side of a tree, while the north wind ruffles up his feathers and the frost makes the wood resound with reports like pistol shots. But just as the last spark of sunlight dies out among the tree tops he hurries off to his bedroom with an occasional shrill chirrup for good night, and stows himself away for a good sixteen hours of sleep. In May the pair construct a nesting hole in a dead branch, usually well up toward the top of the tree they have chosen. They are less given to occupying the same nest for successive seasons than are the flickers, and the abandoned holes, as well as their winter apartments, serve excellently for nesting places for bluebirds and tree swallows, and others of similar habits. During the heat of summer their habits are the same as at other seasons, though they keep more in the shadow of the leaves, and rise earlier in the morning, doing a large part of their sleeping at midday.



IVORY-BILLED WOODPECKER.

The hairy woodpecker is much larger and heavier than the downy, but his color and markings are the same, except that his outer tail feathers are pure white, not barred with black, as in the other species. They are much less abundant than formerly, some years being decidedly rare. Ten years ago, or even less, they were often seen climbing over woodpiles in farmyards on sunny days in the winter. Their habits are much like those of the downy woodpecker, and their cries, though louder, are rather similar. There seems to be no special reason why they should decrease in numbers, for they appear perfectly willing to put up with the conditions of a settled country, and are much less subject to the persecutions of the youthful sportsman than are their larger cousins the flickers.

The arctic three-toed woodpeckers are slightly larger, and are peculiar in having dispensed entirely with the real hind toe, being provided with only three toes on each foot, two before and one behind. The males are easily distinguished by a square patch of yellow on the back of the head.

This species is decidedly uncommon in this latitude, and one may watch patiently for years without so much as getting a glimpse of one, and when at last they do make their appearance it is not by the hundred, as is apt to be the way with northern birds when they see fit to visit us, but scattered singly about the woods and swamps in a manner hardly calculated to attract attention. This is about their southern limit though curiously enough a species almost identical with this one inhabits the forests of Guiana, while the intermediate region can show nothing in the least like it.

The coloring of the yellow-bellied woodpecker is somewhat more complicated, the white being partly replaced by yellow, and the throat and top of the head crimson. Autumn birds are frequently seen without any red whatever, and with the entire plumage so thickly streaked and spotted as to give an effect of dull grayish brown in the distance.

Pileated Woodpecker.

They make their appearance with considerable regularity in the spring, about the middle of April or a little before, singly or in pairs, and seldom in any great numbers. They are decidedly rare throughout the summer, and are seldom very abundant in the fall except in certain seasons, when they outnumber all the other woodpeckers put together, and may be seen in families of half a dozen or more, running about the hickory and oak trees, which appear to be their favorites. Being much more restless and impatient than the downy, they seldom linger long in a place, but keep flying from tree to tree, pecking here and there as suits their fancy, until, finding an especially attractive spot or decayed branch, they settle down for a few moments of hard work, and manage to do considerable execution in a comparatively short time. They are commonly called sapsuckers, and are supposed to injure fruit trees by drilling little cup-shaped holes in the bark in order to drink sap which flows from them. There is no doubt that they make the holes, sometimes thousands of them in a

single tree, but there seems to be little evidence that the trees are ever injured by the process, at all events not enough to offset the advantage received from the destruction of borers and other insects.

The red-headed woodpecker is probably the most generally known and widely distributed species in this country, though rare in New England except, perhaps, in the more southwestern portion. I have seen but two specimens in New Hampshire, the first in the southern part of the State within a few miles of the coast. One hot June day he came flying across the fields and, alighting against the trunk of an apple tree, began hammering away at the bark in true woodpecker style, then, descending to the ground, appeared to search for insects in the plowed earth beneath the tree. After a few minutes he took wing once more and steered off toward the south. Half a dozen years later I saw one flying among the mountains near Lake Winnepesaukee, but had no opportunities for observing it. They were said to be quite abundant in southern New England in the autumn of 1881, presumably migrating visitors from the West, where they are much more common. Like the flicker, this species exhibits a decided fondness for fruits and grain of various sorts, and is generally considered a destructive bird on this account.

The ivory-billed woodpecker, now confined to the Gulf States and lower Mississippi Valley, is generally admitted to be the finest representative of his race. He is nearly two feet in length, with a scarlet crest and white stripes down each side of his neck. A considerable portion of his wings is also white. In the Southern swamps he still carries on the woodpecker trade on a scale in keeping with his size. The alacrity with which he can hack to pieces the decaying trunk of a tree is said to be simply incredible to one who has never had the good fortune to see him at work. The pileated woodpecker, or logcock, is somewhat smaller, with less white on the wings. Formerly abundant throughout the country, this species has retreated and diminished in numbers with the clearing off of the old original forest growth, and is now only to be found in the most secluded woods and mountain regions, and is nowhere common. A few pairs are still said to linger in the western parts of Massachusetts, and I have found unmistakable evidence of their presence in the newly chiseled trunks of dead pines on some of the New Hampshire mountains, but as yet have been singularly unfortunate in never having seen a living specimen.

SABER-TOOTHED CATS.

By S. W. WILLISTON.

OF the family of cats, the *Felidæ* of naturalists, there are now in existence upon the earth about fifty distinct species, nearly all of which are so closely allied to each other that they have received the common designation of *Felis*. Our domestic cat, whose wild origin is lost in history, is a good representative of the family and one of its smallest members. The Asiatic tiger, the largest and most powerful of all, rarely reaches a length of eleven feet, while the African lion falls not far behind in size and prowess.

The habits of all these fifty species are much alike. With the exception of a fish-eating Indian species, they all obtain their food, which consists of the flesh of other animals, by stealth. For this reason they are all, with the exception of the African lion, inhabitants of forests and jungles, rarely frequenting the open plains, where concealment is less easy. No other living animals are so perfectly adapted for carnivorous habits as are they: their teeth are sharp and cutting; their claws long and pointed, and ensheathed when at rest; their body is lithe and flexible. Their intelligence, while perhaps not equal to that possessed by the other great carnivorous family, the dogs, is by no means of an inferior order.

These fifty living species, however, comprise but a small proportion of all those that have lived in the past. More than that number of extinct cats are already known to scientific men, and many others must have lived of which we yet have no knowledge, and perhaps never may. Those fossil cats have been discovered in nearly all of the great regions of the world where their descendants now live. In Australia and Madagascar they have apparently never lived, because these regions were separated from the mainlands long before cats came into existence, and they have never found an opportunity to reach them since. The oldest cats are known from Europe and North America, making their appearance in geological history, so far as we now know, at nearly the same time. In South America they appeared much later.

In no continent have the extinct cats been found in greater variety and abundance than in the United States, and it is not improbable that here is the real birthplace of the family. More than twenty-five species have already been discovered in the United States, and doubtless not a few others will yet be added to the list. The oldest are from the Bad Lands of South Dakota and Wyoming, while others, only a little more recent, are from Oregon. Remains of those which lived much later have been discovered in

Florida, the cave deposits of the Eastern States, from the Indian Territory, Texas, Kansas, Nebraska, and elsewhere. It is not at all improbable that within recent geological history more than one hundred species of cats have lived within the boundaries of the United States, some of them not becoming extinct until after the advent of man himself. The largest species yet discovered is from the famous bone beds of Phillips County, Kansas, associated with large dogs, rhinoceroses, horses, camels, etc., in the Loup Fork Tertiary. This species, though yet known from very scanty material, has been rightly named *Felis maxima* by Scott, and it must have measured thirteen or fourteen feet in length.

While collectively all these extinct species are known as cats, only a few are so nearly related to the living species as to be classed

SABER-TOOTHED CAT (*Hoplophoneus occidentalis*, Leidy).

in the same genus *Felis;* and these few are the most recent of all. It will be remembered that at present only four or five species of cats are inhabitants of North America—the lynx or wild cat, ocelot, panther or mountain lion, and cougar; the ocelot and cougar found only within the southern limits. Cats are almost always inhabitants of tropical or warm temperate regions.

The most remarkable of all the extinct feline animals are those known to naturalists as the saber-toothed cats or tigers, a group comprising the greater part of all the fossil forms. They date back to the earliest times of which we know anything about the family in North America and reach down to the time of man himself. A large

and powerful species described from the Indian Territory by Cope lived contemporaneously with the hairy mammoth, as evidenced by the commingling of their skeletons. There can be little or no question but that the hairy mammoth was contemporaneous with man in North America as well as in Europe. Their geological range is from the close of the Eocene to the latter part of the Pleistocene.

The accompanying illustration will give a fairly good idea of what some of these saber-toothed cats were like. Of course, one can not say that the animals were colored as the artist has represented them in his drawing. Perhaps there is more reason to believe that their markings, if they had any, were spots rather than bars, since spots are more primitive than bars. The figures were made from a skeleton of *Hoplophoneus occidentalis*, Leidy, recently constructed by Mr. E. S. Riggs in the University of Kansas Museum, and the artist had most perfectly mounted models of various recent cats to aid him in the restoration.

The chief peculiarities of the animal as seen in the picture are the extraordinarily elongated canine teeth. It will also be noticed that the tail is of unusual length and that the legs are short. The animal measured about seven feet in length aside from the tail. The lower jaws have a downward projection in front, as the picture shows, due to a flangelike widening of the jawbones, which doubtless served as a protection to the teeth, preventing their injury or loss. In some of the larger forms, from South America, this flange was not present, while the canine teeth were even more elongated than is the case with this species, attaining a length of over six inches and protruding far below the jaws when closed. Indeed, so far did they protrude that it was impossible for the mouth to be opened wide enough to permit anything to pass them. Skulls of these South American saber-tooths have been found, it is said, and one can readily believe the statement, in which the points of these teeth had become fastened in the lower jaws during life, preventing closure of the mouth, and in consequence easing starvation! It is difficult to quite understand just how these animals killed their prey. Doubtless some used their teeth as daggers, with a downward thrust, the mouth being closed. For this use the teeth were admirably adapted, being long, curved, and flattened, with each thin edge finely serrated.

In some of the most highly specialized of these animals the molar teeth in the back part of the jaws had been reduced in number, so that only one remained above and below on each side.

It is a pretty well established fact in natural history that such peculiar characters when once acquired are never lost. If this be

true, it is quite certain that the saber-toothed cats have left no descendants behind them. Throughout North and South America they became extinct almost within historical times, and have left nothing behind them save their bones in the rocks.

THE QUESTION OF WHEAT.

By WORTHINGTON C. FORD,
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III.—RUSSIA.

RUSSIA is the United States of Europe in its economic aspects. An immense territory, much of which is still unused; a population of exuberant fertility and restless wandering, gradually spreading itself over the land; an agricultural basis for its economy; an experience of slavery that was conclusive on its wastefulness and social evils; and an industrial and commercial exclusiveness that has heretofore made it the one great power of the continent of unknown and unmeasurable resources—these characteristics may be found in this country, the opposite to Russia in political practice and social theory. The simile may be extended. For Russia has been urged forward by two potent ambitions. Panslavism created the vision of a united eastern Europe, with Russia at the head, and with a great Russian port—Constantinople—on the Mediterranean. The desire to be the controlling agency in Asia has led the Government to make heavy sacrifices to further that end, seemingly now to be crowned with success. For Russia commands the north of Asia through her railroad, and is in possession of ports on the Pacific which may give her an important share, if not the most important share, in Asia's commerce. No longer shut off from her outlying and half-closed port and fortress of Vladivostock, she has secured southern outlets and connections implying even greater political than commercial power over the destinies of Asia. From ocean to ocean, across Europe and Asia, and from the arctic to the Mediterranean, this huge unformed empire rests, the arbiter in both continents. Is there no likeness in this to the pan-American ambitions of the United States?

In 1870 the population of Russia in Europe was 65,70,559, or about thirty-five souls to the square mile of territory. If Poland and Finland be included, the total population will be increased to 73,504,592, but the density of population will not be changed, as the dense settlement of Poland is neutralized by the sparse population of Finland. In 1897 the total population had increased to 106,159,-

141, of which 94,188,750 were assigned to Russia in Europe, and the density of the population had risen to fifty-one to the square mile. The returns of Russia in Asia are naturally imperfect, but the census of 1897 gave 23,052,000 souls, and the density of population about four to the square mile. For the whole empire the density is fifteen souls to the square mile. This low figure is due to Siberia, where only 1.2 marks the population to the square mile, and to central Asia, which gave only 5.6 to the same territory. Poland is the most densely settled (one hundred and ninety-two to the square mile), and Caucasia does not greatly differ from the average for European Russia (53.3 to the square mile). If these figures be compared with the returns of the United States census it will be seen that European Russia has more than twice the density of population of the United States (21.3); that Poland is as thickly settled as New Jersey (193.8), and that New Mexico equals Siberia in sparseness of inhabitants.

The estimates of land under cultivation in European Russia have become more correct of late years, through the intelligent application of statistical methods by the Government. In 1850 it was believed that about eighteen per cent of the area (exclusive of Poland and Finland) was under cultivation, and of this cultivated portion nine acres in every ten were under grain. Accepting these official figures, the area devoted to grain would have been 219,569,000 acres. From 1850 to 1860 the cultivated ground increased by one tenth, and nearly the entire increase was devoted to grain. The social conditions introduced by the emancipation of the serf checked this development after 1860 in the northern and central government of the empire, but stimulated the settlement and cultivation of the more southern provinces—the black-earth region. The progress as a whole was small, for the gain of one region hardly overcame the loss of another, and in 1870 the figures gave an increase of only 1.5 per cent in the area of plowed land over the returns of 1860. After 1870 the rate of progression again rose, and in 1880 nearly ten per cent more land was in cultivation than in 1870. Again accepting the official figures, the area of tilled land was about 540,000,000 acres in 1880.

In that year nearly sixty per cent of this area was in the "black-earth" zone, a vast and rich arable plain, extending across the empire from the southwest corner (Podolia) to the Ural Mountains, and even reappearing in Siberia. This is one of the largest sections of fertile lands on the globe, and its pre-eminence arises from the decomposition through centuries of accumulated steppe grasses, and the shelter afforded by the outlying forests. "It owes its name to a layer of black humus, varying in thickness from, on the average,

one foot and a half to five feet. The mold consists chiefly of loam, and in lesser proportion of oily clay mixed with organic matters. It dries up rapidly and becomes pulverized in the process; but it becomes with rapidity impregnated with moisture, and under the action of rain returns to its original condition of a sort of dough as black as coal." * The population in this region numbers from sixty-five to seventy-five to the square mile, and is increasing rapidly. In the United States the States producing the largest returns of wheat in 1896 were Minnesota, with a population of 16.4 to the square mile; California, with 7.7; and Kansas, with 17.4. The concentration in the Russian grain region becomes remarkable under such a comparison.

If the returns of cultivated land are defective, the estimates of product are even more open to question. In a report prepared by a Government commission appointed to investigate the condition of wheat in European Russia, exclusive of Poland, the area under winter wheat was given at 6,126,300 acres, and under summer wheat at 20,764,890 acres, or a total of 26,891,190 acres. That was about 1873. In 1892 the wheat acreage of all Russia in Europe, including Poland, was 34,100,835 acres. In 1897 the total area had risen to 36,738,500 acres, of which 24,411,500 were devoted to summer wheat. The gradual extension of territory included in the statistical returns makes comparison from year to year difficult, because the details of each year's aggregate differ. The following table will lack that definiteness which would make it scientifically valuable, yet is sufficiently clear to show the general tendency of wheat culture in Russia since 1872:

Year.	Acres.	Production.	Year.	Acres.	Production.
		Bushels.			Bushels.
1872.....	28,743,390	157,938,000	1885.....	.....	172,378,173
1873.....	.....	157,562,800	1886.....	.....	156,546,447
1874.....	.....	249,107,000	1887.....	.....	269,085,104
1875.....	.....	145,192,000	1888.....	.....	286,476,461
1876.....	.....	154,268,400	1889.....	.....	172,909,590
1877.....	.....	246,285,400	1890.....	.....	206,329,430
1878.....	.....	293,702,600	1891.....	.....	163,475,063
1879.....	.....	166,117,000	1892.....	34,100,835 †	234,034,662 †
1880.....	.....	158,946,000	1893.....	.....	360,104,546 †
1881.....	28,947,011	256,852,000	1894.....	.....	353,629,452 †
1882.....	.....	232,341,000	1895.....	.....	.....
1883.....	.....	212,130,022	1896.....	.....	.....
1884.....	.....	258,562,095	1897.....	36,738,500	340,470,000

From the earliest recorded statistics of exports from Russia, wheat has held an important position. When the repeal of the corn

* Anatole Leroy-Beaulieu. Empire of the Tsars, vol. i, p. 23. † Includes Poland.

laws was effected in England it was from Russia that the "avalanche" of corn was to come to destroy the English farmer and ruin the English landlord. The critical time, however, passed without any disturbing increase of imports from that direction, and Russia quietly enjoyed an increasing demand for its wheat from many quarters. The crucial test of its ability to meet the requirements of its neighbors came in the period of general failure of crops elsewhere, when a higher price for grain tempted the world to send the products to Europe, and on an equal plane of competition. The Russian crops of wheat were very large in 1870, 1874, 1877, and 1881, but in only two of these cases did the export movement expand in proportion. It must be borne in mind that the ability to export is controlled by the food supply of the whole empire. While some thirty-five governments of Russia produce a constant and at times excessive surplus, there are eight governments which vary between a sufficiency and a short supply, and some seventeen districts which never produce enough for their own consumption. The population of the grain districts is one half greater than the population of the other in insufficiently supplied regions, thus giving a home market of no mean size for the rye which forms the staple food of the people, and for some of the wheat. Whatever is not required to meet the home demand is available for export; but it by no means follows that the grain is exported. At this stage intervenes the imperfect economy of the empire—the want or deficiency in railroad transportation, the need of capital with which to move the crops, and the oppressive measures taken by the money lenders, who slowly ruin the peasant to secure a present advantage. The nearness to markets in part compensates for these obstacles, and the want of a large and steady market at home is more than sufficient to overcome the adverse influences which, standing by themselves, would almost prohibit competing in other markets except in famine years. Hence grain goes out in quantities, and is one of the controlling features in the foreign commerce of the empire, at once the result and a constant stimulus to developing this resource.

As late as 1888 the Minister of Finance deplored the want of proper intelligence and machinery among the farmers to get the benefits of the market open to them. In reciting the disadvantages incident to these conditions he wrote: "Being always well informed and not having mortgage charges to support, the American farmer is in a condition to resist more or less the maneuvers of speculation, and can form an idea as to the kind of grain of which the culture can be increased or diminished. With us the situation is very different; not only are the rates of transportation on our railways much higher than those of America (averaging fifty per cent more), but

our farmers are deeply in debt, and are at the mercy of all kinds of intermediary agents whose honesty is not of a very high standard. With regard to this, the singular fact appears that last year, at such an important market as Kharkov, the farmers were not informed as to the prices current of grain; so that oats of the same quality were sold simultaneously at thirty-five cents and seventeen cents and a half the pood of thirty-six pounds. Further, instead of upholding our commerce in cereals with foreign markets, our exporters continue to compromise their reputation. A great number of merchants in London and other seaport markets complained in 1886 that the cargoes of cereals and flax coming from Russia contained an abundance of heterogeneous matter."

Owing to imperfect or expensive transportation, the peasant is not in the best position to obtain the full benefits of markets. "The harvest ended, each man brings his grain to market. Hoping to realize a more remunerative price by carrying his produce to a central or larger market, he makes application to travel. Here the factor steps in. In conjunction or in collusion with the local police, obstacles are thrown in his way week after week. Ten, twenty, or one hundred are in the same predicament. Finally, with the local station or market glutted with the yield of a county, the factor steps in and agrees to take all the grain in sight for about twenty-five per cent below its market value. They have no choice, and thus a crop grown at a cost of twenty-five per cent interest (paid to the factor for advances) frequently pays twenty-five per cent additional after its maturity." * Not only does such a system of handling grain cause loss to the farmer through low prices, but even more through the actual destruction of grain. It is estimated that millions of bushels of grain are lost annually on account of the failure of railways to afford transportation facilities or shelter for grain brought to them for transportation.

Nor is the question of transportation the only indication of inchoate economic conditions. The land is, as a rule, subject to a mortgage indebtedness, which takes each year an appreciable part of the produce. The usurer or money lender (in Russia the terms are almost synonymous) calls for his per cent on loans, and this per cent may range from a moderate rate to one that is virtual confiscation. A failure in the crops only throws the peasant deeper into debt, for he must borrow to obtain seed and food; the latter for immediate support, and the former as a venture in the future. Two bad seasons bring ruin, for the means of obtaining further advances have been exhausted, and only as a tenant, bound to the soil as

* Report by United States Consul-General Way, May, 1889.

closely as was any serf, can the peasant continue to cultivate the land. As every year does not produce a full crop at remunerative prices, it is rare to find farmers free from debts, with the coming crop already mortgaged to the factor in return for past favors.

Although rye is the great cereal consumed in Russia, wheat is also in demand at home. A short crop or a prohibition of import into a market is reflected in the domestic position of that crop. The mere fact that more than one half of the year's product is exported would explain the sensitiveness of Russia to conditions affecting supply and demand. From 1872 to 1880, when importing countries of Europe were obliged to look outside of that continent for supplies, Russia's yield of wheat did not grow as rapidly as seems to have been warranted. The backward and adverse seasons, following one another in almost unbroken line, discouraged an extension of area under wheat, and directed attention to the coarser and hardier grains more generally consumed throughout the empire.

The year 1880 stands out as one of manifold misfortune and disaster to agricultural Russia. The winter of 1879–'80 was of unusual length and severity, and lasted so far into the spring that the food for cattle was exhausted, and large numbers died of starvation. Storms of hail and rain caused great destruction, and the appearance of beetle and cattle plagues added much to the loss and suffering of the population. Had not the Government intervened, with supplies of grain for food and seed, and with public works undertaken for the relief of the starving, a famine of portentous proportion and permanent results would have been experienced. Want and suffering led to a veritable epidemic of diphtheria, "which carried away almost the whole child population of large villages." It was significant that this economic misfortune led to a social change of some moment. "The landed proprietors of the country (around Odessa) are, almost to a man, bankrupt and ruined, and the real property of the country is speedily passing into the hands of the Jews, who manage to make money from it where others starve. They divide the land into holdings, which they let to the peasants, and make a very handsome income of it."

It is remarkable how regularly the wheat production of Russia has fallen short. Beginning with 1880, already given, the next approach to failure was in 1886, with a crop of 157,000,000 bushels; and again in 1891, when 163,500,000 bushels only were gathered. Every fifth year is thus marked, and it is in these exceptional years that the real strength of the Russian wheat interest is to be measured. The year 1891 stands prominently as the year of famine (*année de disette*).

In the fall of 1891 Russia took the somewhat unusual step of

prohibiting the exports of all kinds of cereals except wheat, and in November the prohibition was extended to wheat. As Germany obtained more than eighty-five per cent of its imported rye and more than half of its imported wheat from Russia, the measure was at once reflected in the prices of grain throughout Europe. The first explanation was that Russia sought to retaliate on Germany for the open hostility of Bismarck to Russian financial operations in Germany; but this explanation was based upon a mere supposition, and one that could not account for the general condition of the wheat market outside of Germany. The true reason came to light slowly, and in spite of the efforts of the Russian Government to conceal the gravity of the situation. It was a true famine from which Russia suffered. Both the spring and winter wheat gave very unsatisfactory returns, and one third of the provinces were appealing to the Government for the means to feed their people. The harrowing descriptions of extreme sufferings, of fearful destruction of men and cattle throughout the stricken regions, and of the comparative impotency of the administration to cope with the emergency, startled the civilized world, and brought aid even from the United States. So great a deficiency in Russia as almost to prohibit exports was aggravated by the very poor returns of grain crops throughout Europe. The price of a pood of wheat at four great markets of Russia was:

	1890 Kopecks.	1891. Kopecks.	1892. Kopecks.	1893. Kopecks.	1894. Kopecks.
St. Petersburg	96.5	118.4	114.6	99.4	78.9
Riga	94.5	118	118.9	96.0	71.8
Odessa	89.2	107	89.8	71.3	58.5
Saratow	74.2	105.3	106	82.8	58.8

This range of prices is sufficient to warrant the name of famine year to 1891, an experience from which Russia did not recover until 1894, and from which important lessons in administration were drawn.

Scarcely had the full effects of the deficiency of 1891 been realized when a new complication arose in the serious commercial rupture with Germany. A treaty of commerce was in process of negotiation between the two powers. German manufacturers, who enjoyed a large market in Russia, complained that discriminating duties were imposed upon their products on the frontiers, and commercial treaties with other states were imposing obstacles on their operations. Russia assumed that Germany was dependent upon her for cereals, and desired as liberal concessions on grain as were given to any outside power. Germany had determined to yield no point

on those duties, pointing out that the successive increases in the German tariffs in 1879, 1885, and 1887 did not hinder the development of Russian exports to Germany, whereas the Russian tariff legislation had produced a distinctly injurious effect on the trade of Germany. For nearly two years the negotiations for an agreement were continued, to be abruptly broken by the announcement on the part of Russia that the maximum tariff would be enforced against Germany after July, 1893. As this meant an increase of fifty per cent in all duties on German goods, Germany retaliated by imposing a corresponding penalty duty on all imports from Russia.

In 1891 the dutiable imports into Germany from Russia were 400,000,000 marks, of which 91,000,000 marks were in wheat. In 1879 the duty collected on wheat by Germany was fixed at one mark per one hundred kilos (twenty-four cents). This rate was in 1885 increased to three marks (71.4 cents), and in December, 1887, to five marks ($1.19). Under treaty arrangements the duty on wheat could be reduced to 3.50 marks (83.3 cents), but Russia did not enjoy this concession. In spite of this discrimination the trade in wheat progressed, and would have continued to increase, had not the disaster of 1891 occurred in Russia, and the tariff war followed. The effect on the total movement of wheat from Russia and on the exports to Germany is shown by the following comparison:

Year.	Russian exports.		German imports.	
	Total poods.	To Germany. Poods.	Total kilos.	From Russia. Kilos.
1889	190,545,698	14,110,471	516,887,000	301,247 000
1890	182,085,036	10,714,805	617,587,000	370,823,000
1891	176,369,063	17,931,110	905,332,000	515,212,000
1892	81,555,790	3,255,753	1,296,213,000	257,299,000
1893	156,229,650	2,724,043	703,453,000	21,636,000
1894	.....	.....	1,153,837,000	280,594,000

Fortunately, an agreement between the two countries was reached in March, 1894, but all of a year was required to correct the injury inflicted on this branch of Russian export trade.

Within eight years Russia's wheat interests have thus been subjected to severe tests, and have endured in a remarkable manner. It now becomes necessary to give some attention to the internal economy that makes this elasticity possible. The cost of production is a mere detail when set against the social revolution implied in the change from serfs to peasant farmers.

Any estimate of actual cost of production of wheat in Russia must be based upon so many different conditions as to afford little satisfaction. No two governments of that immense and variegated empire would return the same averages; and to complete a general

and acceptable average would defy every known statistical method. Yet the attempt has been made in connection with the competition from the United States, and the result was published with the official recognition of the Minister of Finance. There is little doubt that this comparison deserves to rank with the curious French and English estimates already quoted—estimates which sought to determine an arbitrary limit of cost below which wheat could not and therefore would not be grown in the United States. It will be of interest to make a record of the Russian estimate, if only for future reference and comparison. "A pood, or thirty-six English pounds, of wheat costs the Russian producer fifty-six kopecks, or twenty-eight cents, whereas the same quantity of American wheat costs the producer sixty-six kopecks, or thirty-three cents. The transportation of this cereal from Russia to London costs about nine kopecks per pood, or four cents and a half, whereas the American exporter pays 9.7 kopecks, or 4.85 cents, per pood to transport his grain to the English markets." *

In the black-earth region the cost of production, including rent, was said to range from forty-five to sixty kopecks per pood, and even at the higher cost would have yielded a profit to the cultivator if sold at the market price. This made possible a fall of more than one fifth in the commercial value of wheat between 1881 and 1887, without affecting the production in any noticeable degree. In most cases, however, the profit was apparent, and the debt-burdened landowner derived little benefit.

In 1838 the serfs numbered forty-four out of every hundred in the population of Russia in Europe, but at the time of emancipation the proportion was less, and tended to diminish each year. The serfs on private domain, forming about one half of the total number of serfs in the empire, constituted the readiest asset of the proprietor for obtaining loans from the credit establishments of the state. So far was this practice carried, that at the moment of emancipation two thirds of these serfs were found to be so mortgaged. The act of emancipation transformed the serf into a landowner, and through this ownership and the autonomy of his commune he was supposed to be fully emancipated, at once economically and administratively. As compensation was due to the nobles for the land thus given to the freed serf, the state undertook to loan four fifths of the established value of the land, whenever the serf should wish to request that aid. The advances were made on a basis of a period of forty-nine years at six per cent, the annual payment of six per cent covering the interest and finally extinguishing the debt. The process of emancipation is thus still short of completion.

* Based upon a report issued in 1889 by the Russian Ministry of Finance.

Other circumstances had interposed to check the intended operation of this great economic revolution. In 1880 over one fourth of the peasants in the eight governments composing the richest region of the empire, comprising the agricultural zone of the center, were under "temporary obligations," and thus far from perfect freemen. "In the more fertile regions of the black-mold belt, where, owing to the outlets opened by the railroads, the value of land has rapidly increased, the landlords frequently found it to their advantage not to consent to its redemption, so as to retain the compulsory services of the peasants. Now the statute did not give the peasant the right to demand the redemption; this right belonged exclusively to the master, and all that the peasants could do in such a case was to reduce their lots to the legal minimum allowed for that particular locality." * To hasten the end, Alexander III made redemption obligatory.

Although nearly forty years have passed since the ukase of emancipation was promulgated, it is still too early to give a definite judgment upon its results. The expectations of its framers have not been attained, in part because of the immensity of the task and diversity of conditions to be met, and in part because the immediate application of the ukase was made not by those who had thought out the scheme, but by others, who were either indifferent or even hostile to the measure. The serf has not generally become an independent landholder, nor has he gained that economic self-reliance that was so ardently desired. He is even less able than before to encounter a bad season, short crops, or a cattle plague, for he has no master who may make good his losses and help him to tide over his difficulties. On the other hand, the peasant has not secured what he believed to be his rights, and is not a little discontented that his dream of full and free possession of the land has not been fulfilled. The many and increasing taxes bring home to him the responsibilities of property, but give him little for meeting the increasing burdens. "Great is the number of peasants who, to-day, pay taxes and dues as heavy as in the time of serfdom, while they have less land, less forest, often less live stock, and less credit than before the emancipation, which, under such crushing conditions, could not rapidly augment the well-being of the people nor improve the culture of the soil. It has frequently enriched wealthy districts, and sometimes appears to have still more impoverished poor ones. Official statistics have ascertained that in many localities the cattle had diminished in number, hand in hand with the lack of cattle goes that of agricultural implements and of manure, so that the peasant's already primitive mode of farming not only has not improved, but has in

* Leroy-Beaulieu. The Empire of the Tsars, vol. i, p. 443.

places actually deteriorated since he is free. The soil has become exhausted, the fields have even sometimes been abandoned, so that in many regions bad crops and dearth have come to be of almost regular occurrence."

The helplessness of the peasant, the importance of food supplies, and the necessity of foreign markets for surplus product have induced the Russian Government to devise an extensive system of state aid, apart from the measures arising out of the emancipation. This policy was initiated in 1888, and offers a most elaborate plan for facilitating the marketing and transportation of grain, without endangering the home supply. It was formerly the practice among rural communities to set aside a certain quantity of grain each year of good return to be held as a store against a deficient crop or actual famine. This salutary system had been allowed to fall into disuse in many governments where the development of agriculture seemed to promise an immunity from want or even from high prices that are inseparable from a really short production. The events of 1891 gave a rude shock to this feeling of confidence, and the Government determined to enforce the old system of storing grain, or to create a fund out of which actual suffering through a partial famine could be relieved. The Minister of the Interior, in calling the attention of the local authorities to this matter, proposed two methods of attaining the end desired: (1) by returning the grain borrowed, where a general store has been maintained, and filling new storehouses; or (2) by substituting a grain tax where the old stores have not been kept up, for a money tax designed to make a fund for the purchase of supplies when needed.

"The Ministers of Finance and of the Interior have solicited the imperial permission for giving the zemstvos the right to collect the land tax from peasants in grain instead of money, and that, furthermore, in order to give the zemstvos means to meet the necessary expenses, a credit should be opened for them in the Government bank at the low rate of three and a half per cent per annum and to the full amount of the sums they were entitled to receive in grains. The loans thus made must be returned to the bank out of the money received from the sale of the grain, or, if necessary, from special taxes, and not later than June 1, 1894." *

A second object to be gained through state agency was to relieve the peasant from the necessity of selling his grain as soon as gathered in order to provide the means of continuing the operations of the farm.

Since 1888 liberal loans have been made to farmers on grain stored in warehouses or delivered to the railroads. These advances

* Consul-General Crawford's report, December, 1893.

are not to exceed sixty per cent of the current price for the grain at the nearest market place, and run for six months, or even for one year. A short-time loan, for six weeks or less, may reach eighty per cent of the current price. In every case the rate of interest is at least six per cent, but varies according to the condition of the grain and the nature of the security. Should the borrower default, the grain is sold at public auction by the railroad, which acts as the agent of the Imperial Bank, whence all the loanable capital is derived.

In actual practice the system does not meet with the success anticipated by its framers. Not only is the capital available for advances inadequate, but the ability to loan is given only on grain actually delivered to the railroads or stored in central warehouses on favored routes. For the grain retained in the peasant's hands no provision will apply. The natural result is to stimulate the moving of the grain away from the place of production and, as experience has often proved, away from the market where it may be most needed. To secure the widest application of the loans, the Government entered into arrangements with private banks, supplying them with the capital to advance on grain, and offering them a profit on the venture.

The Government also undertook to facilitate the marketing of grain. The current prices of the leading cereals were published at all railway stations with a view to instruct the peasant of the condition of the market. The railway tariffs were subjected to a severe examination, that there might be no gross discriminations in rates against certain localities, or through differences of distances. The actual freight charged could not at once be reduced to a complete and consistent system; but the power of the Government to control the rates made itself felt wherever an emergency pressed. When Germany excluded the wheat and rye of Russia from her territory, the Russian Government reduced by nearly one third the cost of transporting grain to the Austrian and Roumanian frontiers. This gave a saving of twenty-five dollars a car, or about six cents a bushel, on wheat carried farther than six hundred and sixty-three miles (one thousand versts), and enabled the exporter to sell his grain in markets where he had not found a ready sale because of the cost of transport.

The development of railroads in Russia has been slow, and controlled rather by military than by commercial factors. In 1871 there were 7,750 miles opened to traffic, of which no less than 4,523 miles had been opened between 1868 and 1871. In 1874 the mileage had risen to 10,368, and between that year and 1890 the length of lines in European Russia alone increased to 18,059 miles. Toward the end of 1896 the returns for all Russia gave 25,898 miles open to regular public traffic, of which two thirds were owned

and worked by the Governments of Russia and Finland, and nearly 5,600 miles were under construction.

From time to time reports have come of the immense wheat possibilities of Siberia. Growing in definiteness as the land became better known, they yet have not attained to such a degree of accuracy or distinctiveness as to give a basis for testing their truth. As early as 1888 the representative of the United States in Russia reflected some of the glowing accounts. There were "vast bodies" of land in southern Siberia, capable of producing "an unlimited quantity" of all cereals. "Along the banks of the Obi, Yenisei, and Lena, and for hundreds of square miles between them, the land is a garden spot, the soil consisting of a rich, black earth. . . . It is virgin soil, and is as rich as the delta of the Nile. Owing to lack of transportation, the prices of land, grain, meat, and labor are ridiculously low."

In the famine year, when it may be assumed that all available sources of grain were drawn upon, about 9,000,000 bushels of Siberian grain were purchased, and it was stated that more than 6,000,000 bushels more could have been obtained had the means of transporting them existed. The sales in such an exceptional year can not be taken to represent the usual available quantities, and the possibilities of marketing at such distances are yet to be tested.

Thus Russia stands on wheat where the United States stood in the middle of the century. Her farmers are hampered by lack of transportation, by debts, and by the survivals of a *régime* of serfs. In Europe, Russian wheat finds a ready market, naturally protected against outside competitors by propinquity or geographical position. But the peasant of Russia will consume more of his product each year, and it is very doubtful if the wheat capabilities can develop to such an extent as to place the country in a position to command her present market. An economic revolution must first be accomplished, and there is evidence of its approach at the present time. It may be checked by the Asiatic ambitions of the Czar, but on its accomplishment depends the future of wheat in that great empire.

"PASTEUR," say Dr. and Mrs. Percy Frankland in their biography of him, "only worked at his ease in silence and meditation; in his vicinity he only tolerated his assistants; the presence of a stranger while he was occupied sufficed to disturb his work. One day, on going to visit Wurtz at the École de Médecine, he found the great chemist surrounded by students, the laboratory resembling a hive full of bees in its bustling activity. 'How,' exclaimed Pasteur, 'can you work in the midst of such commotion?' 'It stimulates my ideas,' replied Wurtz. 'It would effectually banish all mine,' was Pasteur's answer."

EYE LANGUAGE.

By LOUIS ROBINSON.

NO part of the human countenance engages our attention so frequently as the eyes. When face to face in conversation, we do not look at the lips—although, as a rule, the attention is very quickly taken by any movement—but at the eyes of the person with whom we are speaking. So much is this the case that the habit of many deaf people of watching the mouth always strikes us as peculiar. In fact, one usually feels that there is a sense of incompleteness in the association of mind with mind by means of conversation if there is not a continual interchange of glances making a kind of running commentary on the words spoken. The same may be said of ordinary greetings when two people shake hands: unless there is at the same moment a meeting of friendly looks the ceremony loses much of its meaning.

Now why is there this continual meeting of eyes accompanying all kinds of human intercourse? Partly, no doubt, it is attributable to certain habits of comparatively recent date. The eye, "the window of the soul," is a more truthful exponent of the inward thoughts than the tongue, and seeing that speech is very frequently used not to tell the thoughts but to conceal them, we look to the eye for confirmation or the reverse for what our ears are taking in.

Partly, I think, the habit is based upon an inbred instinct which we have inherited from very remote ancestors, and which is exhibited by many of the lower animals. One finds that very young children, long before they acquire any knowledge of words, establish an understanding with those about them by means of the eye. A babe of a few months old directs its glances to the eyes of those round about it quite as much as an older person. A dog watches its master's eyes habitually, and, as will be shown later, monkeys use this method of ascertaining what is in the minds of those round about them almost as much as we do. Many wild creatures instinctively understand when they are being looked at. Thus a hare in her seat will often allow a man to pass close by her if his gaze is directed at some other object, but when she sees his eyes turned toward her she seems to know that she is discovered, and is up and away in an instant.

Is it not Oliver Wendell Holmes who draws attention to the automatic way in which we challenge the eyes of those we pass in the street, and thus establish, every time we walk abroad, a species of understanding with many persons who are otherwise complete strangers? It is not too much to say that mind begins to communi-

cate with mind at the moment when the eyes encounter, and that people whom we have acknowledged in this way stand on a somewhat more familiar footing with us than before the vague bond became established.

We, most of us, feel a hesitation about making our presence known, even to a friend, by any other form of advance. The beggar has long ago discovered that he gains by this most informal method of self-introduction. This fact has been brought home to me of late while I have been interested in ocular expression, and have made a habit of looking—perhaps rather more intently than is customary—at the eyes of persons whom I meet upon the pavement. If any member of the cadger fraternity happens to be on business in the streets, he is certain to regard the momentary interchange of glances as an invitation to attempt some more profitable form of commerce. The commonness of the habit can not be better emphasized than by calling attention to the fact that members of Parliament make use of the same mute telegraphy as mendicants when they desire permission to address the House.

Fencing masters lay great stress upon the importance of pupils keeping their eyes steadily upon those of their opponents. In all probability Nature herself would teach any of us this elementary lesson if we were face to face with a real enemy. I have noticed that all pugilists, trained and untrained, when sparring keep their gaze fixed upon the eyes of their antagonists. That such habits are instinctive is shown by the fact that all apes when they have hostile intentions invariably look steadily at the eyes, and never allow their glance to stray.

When we study the natural history of ocular expression we soon find an explanation of these facts. Obviously the nervous mechanism of such primitive and widely distributed methods of intercourse must be very ancient, and can have but little to do with the higher intellectual faculties. Undoubtedly eye language dates back far beyond the beginning of human speech, and was therefore established at a time when mental processes were infinitely less complex than they are to-day. One must not attribute the superior truthfulness of the eye over the tongue and the other organs of expression to any causes which have to do with morality. Nature knows nothing of ethics as we understand the term, and if she can gain an infinitesimal advantage by deceit she resorts to it without the slightest hesitation. But, unlike many human exponents of the art of lying, she is frugal and businesslike in her output of falsehoods. If it does not pay her to tell a lie her veracity is beyond suspicion. Broadly speaking, the language of the eye is the language of truth, because it was evolved at a time when elaborate lies were useless. When

there were no highly developed brains social strategy of the more oblique kind was uncalled for, just as hundred-ton guns were uncalled for before the days of ironclads. We know that the development of the critical and plotting part of the brain is of comparatively recent date, but that the mechanism of the emotions and the more automatic mental processes is extremely ancient. Hence the surviving methods of communication which belonged to the earlier ages, and are closely connected with the machinery of emotion, do not so readily lend themselves to civilized mental artifices as the comparatively new-fangled organs of speech. They are to a great extent independent of the conscious will. I shall endeavor to explain, when discussing the physiology of ocular expression, how it is that the eyes maintain their pristine simplicity and often betray the lying tongue.

In his treatise on the Anatomy of Expression, Sir Charles Bell draws attention to the fact that the changes which take place in the appearance of the eye are due chiefly to the surrounding structures, and not to alterations in the eyeball itself. When, therefore, one is discussing the causes of ocular expression, it is necessary to take account of the muscles of the brow and also of those which surround the orbit. I think, however, that the eyeball *per se* undergoes more change under the influence of emotion than has been supposed. It has been said that the glistening or sparkling of the eye is simply the result of the ball being compressed from the outside; but careful experiments seem to show that the orbicular and other muscles surrounding the eyeball have less constricting power than they have received credit for. One finds, both in man and in animals, that the eye is capable of sustaining a good deal of pressure from the front without any marked change in its general aspect. Any one who has observed the large cushion of fat which lines the roomy orbit, and which forms a soft bed for the ball, will understand how easily the eye evades pressure from the orbicular muscle. Of course, if all the little muscular straps which proceed from the back of the orbit, and are attached to the sclerotic, were to contract vigorously at the same time, ocular tension might be sufficiently increased to cause the front surface to be tight and glistening. But it will be plain to every anatomist that if this took place the eye would be completely disorganized as a visual apparatus, because the distance between the lens and retina would be so increased as to throw the focusing machinery completely out of gear. The effect of pressure so applied would be to make the eye extremely short-sighted. Now, it is quite possible to have the eye sparkling with emotion and yet retain the normal powers of sight. We must look elsewhere for the mechanism of the sparkling eye, and I think we shall find it in

the parts controlled by the sympathetic nerves which regulate the condition of the blood-vessels and their minute continuations. This will perhaps be best discussed a little later, when some points in the physiology of the eyeball which bear upon expression are dealt with.

The relation of the brow to the eye greatly influences its expression. If one examines the eye of an eagle one finds that its impressive aspect greatly depends upon the fact that it is overhung by a lowered brow. Although we speak of an "eagle eye" in a human being, there can be no doubt that it is the unconscious application of human physiognomical standards to the bird which makes us think its expression so imposing. The eagle has in an exaggerated form certain ocular characteristics which in a human being are a sure sign of formidable qualities. A clear and steady gaze—possibly emphasized by the sparkle indicating some fierce emotion—from beneath a lowered frowning brow means a great deal when seen in a man. Throughout all Nature a steady eye indicates courage. The possessor is confident in his own strength, and does not feel the need of looking hither and thither either for succor or for a way of escape. This fearlessness and fearless aspect under natural circumstances is generally fully justified. It is only when it is backed up by such physical qualities as to give a fair prospect of success in any encounter that warlike courage is one of Nature's conservative forces. Otherwise it would obviously expose its possessor to grave risks of extinction. It is because this sign of courage seen in the countenance is also almost invariably a sign of formidable power that it is so universally held in respect. In the "eagle eye" one has this bold clear glance, and above it the suggestion of a frown. Now a brow of this character usually means two things: First, that there is some feeling of resentment; and second, that the mind of the frowner is made up as to some course of action. When these are added on to the other qualities indicated by the "eagle eye," one naturally feels that the man displaying it is not one to be trifled with. Most savages frown horribly when they wish to intimidate their foes, and it is said the Chinese recruits are exercised in this maneuver as thoroughly as ours are in accomplishing the "goose step." Their words of command (as commonly reported) are, "Prepare to look fierce! Look fierce! Advance on the enemy!"

I am inclined to think that we have a remnant of this self-same piece of strategy in the peaked caps still worn by the soldiers of several nations. The cap which one sees most commonly represented in pictures of the French troops in the Franco-German War brings a frowning look to the brow, and shadows the eyes in such a way as to give the face a very stern and soldierly *ensemble*.

I remember being greatly struck with the transformation effected

in the look of a number of "sandwich men" in the Strand who had been dressed up in cast-off French uniforms. The men seemed all of the feeble, woe-begone class from which sandwich men are usually recruited, but under the shadow of the military caps their faces looked stern and resolute, and their eyes had quite lost that watery, vacillating look which is engendered by alcohol and despair.

Sculptors and painters almost always exaggerate the brow and the shadow it casts when representing idealized human figures. It is an essential of the manly type of beauty to possess this certificate of manly qualities. We all know how weak and unimpressive is the prominent eye which is not shadowed by a lowered lid or brow. The reason of this is that people with such eyes have a startled look similar to that of a frightened animal. It is one of the painful duties of a physician to watch the facial changes which take place in various diseases, and in one known as *exophthalmic goitre* the eyes tend to become more and more prominent. The result is that the face has an aspect which so exactly simulates the expression of sudden fear that it is often difficult to believe that the patient is not feeling great alarm.

We are constantly influenced by the automatic tendency to form judgments about the character from ocular expression when we come in contact with those whose eyes are altered in appearance by accident or disease. Thus when a person is suffering from the involuntary to-and-fro shifting of the eyes known as *nystagmus*, it is by no means easy to believe in his sincerity. Probably all of us feel an instinctive prejudice against individuals who squint. The fact that the two eyes are looking in different directions creates an involuntary suspicion of double dealing. This is especially the case when the squint is an external one. Here obviously the fault is in the understanding of the spectator, and not in the moral character of the unfortunate who squints. It is the unreasoning "old man" who is within every one of us who insists on disbelieving in the virtues of a squinting *vis-à-vis*. Doubtless in those days of pristine simplicity when the ancestral "old man" was in his prime, and as yet incapable of articulate speech, the necessity of understanding ocular language was so great that any being whose eyes were a complete puzzle was justly regarded with distrust. Nearly all monkeys become angry and suspicious when looked at by a person who squints. When we reason the matter out we recognize that this distrustful feeling toward strangers who have crooked eyes is perfectly absurd, and that obliquity of vision can be no possible index of perverted morals. We all feel the prejudice, nevertheless!

Probably the world-wide superstition concerning "the evil eye" has arisen from the sinister aspect of a squint. Bret Harte, in The

Right Eye of the Commander, tells how a whole settlement was well-nigh ruined through its benevolent chief purchasing a staring glass eye from an astute Yankee trader. According to the narrative, this so altered the expression of the commander that even his intimates began to fear him, and it soon became rumored among the Indians that he was possessed with a devil. Possibly the uncanny effect produced by an ill-fitting glass eye is enhanced by its stony stare, resembling that of the abhorred serpent.

Emotion is largely shown in the eye—as elsewhere—through the medium of the sympathetic nerves. These are almost always outside the direct control of the will. One of their chief functions is to regulate the caliber of the blood vessels. Many people are painfully conscious that they are quite unable to keep themselves from blushing. When we blush, the sympathetic ganglia in the neck which control the facial circulation allow the small arteries to dilate, and hence the surface of the skin becomes suffused with red. Now the front surface of the eyes, although apparently non-vascular, is really filled with a network of microscopic canals containing a clear fluid. These are so minute that even the tiny red corpuscles of the blood can not enter them except under exceptional circumstances. Nevertheless, they, like the other channels of the circulation, are controlled by the sympathetic nerves, and when these give the command they become distended with lymph so as to lend to the *cornea* and *conjunctiva* a tense glistening aspect. We all know that the eyes become bright under the influence of fever, and this is obviously because the tiny lymph channels, like the larger vessels which convey the blood to the skin, are dilated and full of fluid. This, I think, is a satisfactory proof that the glistening of the eye does not wholly depend upon the muscular pressure from without. Not only do the sympathetic nerves regulate the brightness of the eyes in the manner above mentioned, but they are also the agents in bringing about changes of expression due to the enlargement or contraction of the pupil. Perhaps it may be as well to remind those of my readers who have not studied the anatomy of the eye that the pupil is a little window admitting the light to the ocular chamber, and that its diameter is regulated by the involuntary muscular fibers of the iris. Until comparatively lately there seems to have been a good deal of difference of opinion as to the action of the pupil under the influence of emotion. About five years ago I had some correspondence with Sir S. Wilkes, the distinguished president of the Royal College of Physicians, upon this very subject, and he informed me that after long inquiry he had been unable to get any trustworthy information as to how the pupil behaved in the lower animals when they were under the influence of emotion. The correspondence had

been called forth by my stating in an article on Canine Morals and Manners (lately republished in Wild Traits in Tame Animals) that a dog's pupils dilate when he is angry. The evidence upon which I based this statement was gathered at the house of a friend who had a fox terrier which used to become furious when teased. It had a basket in the corner of the room to which it retired when offended. The light from the chandelier shone full upon its face, and I frequently observed that when the animal was especially angry the eye chambers reflected the light in the same way as do those of a human being when the pupils are dilated with atropine. Having no quarrel with the animal myself, I could approach him with safety when others were exciting his wrath, and found that on such occasions the pupils of his eyes were widely open. It so happened that about the same time Sir S. Wilkes had been making observations upon parrots, and found that the pupil contracted when the birds were under the influence of anger. On extending my observations to other animals, I found that cats and monkeys exhibited the same peculiarity as the dog when enraged and meditating mischief, but that in several instances, as soon as the creatures were provoked beyond endurance and flew at their persecutors, the pupils suddenly contracted. I offer the following conjecture as to the reason of this phenomenon: When an animal is angry and face to face with a foe, but has not made up its mind as to the most effective method of attack, it is important that the eyes should take in as much as possible of the enemy and his surroundings; but when the actual onslaught is made, the attention of the assailant is fully concentrated upon some particular point of his adversary's body.

One of the most remarkable instances of dilatation of the pupil during anger which I have observed was in a black panther at the Zoölogical Gardens. This dangerous brute, which had injured several people and was usually kept in the background away from the general public, sprang at the bars when the keeper touched him with a stick, and his yellow circular irises became narrowed to mere bands, so that the pupils were enormously dilated. This gave the eyes an expression of indescribable ferocity, for they reflected so much light from their interior as to appear as if red flames were glowing within.

There seems to be a good deal of doubt as to the reason why the eyes of animals shine in the dark. One often hears it stated that the eyes of certain beasts emit light on their own account as if they were phosphorescent. I have never been able to verify this statement, and am inclined to think that it is a mistake. In all cases where I have personally observed this shining of the eyes, the light has obviously been reflected. Our attention is usually drawn to the phenomenon

when a creature is in a dark corner and we are between it and the light, or when we are carrying a lamp or candle at night-time. When it is dark the pupils of all animals naturally dilate almost to their full extent, and therefore the sudden appearance of an artificial light finds the eyes in much the same condition as they would be in if under the influence of atropine. Any one who has taken a bright lantern into a cow stall or stable at night must have been struck by the glinting eyes of the animals turned toward him. Pot hunters, in the days when deer were plentiful in America, used to go out at night with an assistant carrying some blazing pine knots just behind them. The eyes of the startled deer with their pupils dilated with terror and darkness at once afforded a deadly mark to the "sportsman." The method was not without its dangers, especially in the settled regions, and innumerable tales are told of domestic animals having been shot by some careless "fire hunter."

I have never been able to make out why the light coming from the eyes of most animals seems to be almost as pale as that from the glowworm. Wehn we examine the human eye with an ophthalmoscope the light reflected from the retina is red, because that membrane is filled with a network of innumerable blood vessels. The eyes of the enraged panther mentioned above threw back a distinctly red light, but usually, especially when one is at some little distance, eyes shining in the dark look of a pale-green color.

Other emotions besides that of anger seem to cause an enlargement of the pupils, but it is by no means easy to explain why this should be the case. Like most of the functions which are under the control of the sympathetic system, exercise increases the tendency. Hence, wherever one sees a person whose pupils dilate or contract very readily, one may at once infer that one is dealing with an emotional and excitable nature.

I shall not attempt on this occasion to point out all the peculiarities observable in the human eyes which aid us in reading character, and, moreover, it would be exceedingly difficult to analyze verbally some of the intuitive judgments we form from such sources every day of our lives. As was remarked above, such judgments are frequently based upon mere instincts, and seem to spring from those lower mental centers which we possess in common with the lower animals. One generalization which was made several years ago by my friend Mr. J. A. Fothergill is, however, worthy of mention. When the eyes are somewhat prominent and are half veiled by drooping lids (a type well marked in the late Lord Beaconsfield), it is almost invariably a sign of superior mental qualities.—*Blackwood's Magazine.*

PRINCIPLES OF TAXATION.

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XVIII.—THEORY AND PRACTICE OF INCOME TAXATION. (CONTINUED.)

THE income-tax experiences of the United States are so little in accord with those of any other people or countries that their consideration with a view of obtaining a practical acquaintance and comprehension of the whole subject would seem to be best facilitated by grouping their most important characteristics under three heads—namely, their origin and history and undoubted influence on the political and fiscal policy of the nation.

Under the great financial necessities of the Federal Government by reason of the war the attention of Congress was directed to an income tax as a source of revenue as early as the summer of 1861; and in that and the following year laws establishing such a tax were enacted. Their provisions were, however, so complicated, and the methods authorized by them so inquisitorial, that the Commissioner of Internal Revenue reported in 1863 that they deprived the tax "of all claims to public favor." The revenue returns under such circumstances were very moderate: $2,741,858 in 1863, and $20,294,000 in 1864. In this latter year a more comprehensive and effective law was enacted, which was followed by better results, the collections to the credit of the income tax rising from $32,050,000 in 1865 to $72,982,000 in 1866, and $66,014,000 in 1867. But as the necessity for very large revenues on the part of the Government ceased with the termination of the war, and the spirit of patriotism engendered by the war on the part of the people abated, the collections fell off very rapidly. Thus, between 1866 and 1867 the total receipts on account of the income tax, without any change in the law, declined from $72,982,159 to $66,014,000; and in 1872, with an exemption of $2,000, only 72,949 persons in the United States, out of a population of over 39,000,000, admitted under oath that they were in receipt of any income liable to taxation in excess of the exemption. Those only who were officially and intimately connected at this time with the Internal Revenue Department of the United States Treasury can form any adequate idea of the amount of perjury and fraud that characterized and pervaded the country, during the years 1867 to 1872, as the outcome of the then existing system of internal revenue. And American ingenuity was never more strikingly illustrated—not even by the exhibits of the patent office—than it was at that time in devising and successfully carrying out methods for evading the taxes on incomes and distilled spirits.

One curious feature of Federal experience with this tax, the tolerance of which would now be regarded as incompatible with any just and efficient administration of it, was, that the returns made under it were thrown open to the public; and one commissioner of internal revenue instructed his officials to have them published in the pages of local papers, "in order," as he said, "that the amplest opportunity may be given for the detection of any fraudulent returns that may have been made." This idea did not, however, find much favor with the public, who, in fact, during the later years of the tax, were inclined to regard with great equanimity all successful attempts to evade it.

The income tax ceased to form a part of the internal revenue system of the United States after the year 1872. It was, however, made a part of the tax system of several of the States, and the following record (hitherto generally overlooked by the public) of the recent administrative experience of one State ought to be especially worthy of the attention of those who advocate the readoption of this form of taxation by the Federal Government.

No State in the Union has a more illiberal, all-pervading system of taxation than Massachusetts, and in no State is the administration of tax laws more stringent or arbitrary. What Massachusetts fails to accomplish in the assessment and collection of taxes would, therefore, seem to be of little use for any of the other States or the Federal Government to attempt with any anticipation of success. This Massachusetts system finds its fittest exemplification in the city of Boston; and the officials who constitute its department of municipal taxation never indulge, as the taxpayers well know, in much sentiment in the discharge of their duties. The acknowledged representative of this board for many years never hesitated to say that he recognized but one principle, and that was, that in matters of taxation the taxpayer had no rights which the State was bound to respect; and, as chairman of a State commission which some years ago made a report to the Legislature, and with the Declaration of Independence confronting him with its assertion that it is a self-evident truth that "all men are endowed by their Creator with certain inalienable rights," he also gravely asserted that "the individual person [in Massachusetts] has no inalienable rights except that to his own righteousness."

One of the specialties of municipal taxation in Boston, under the supervision of its Board of Assessors, is an income tax, and its methods of administration are substantially as follows: Taxpayers are required to make a return annually, and in detail, of all their property which the law makes subject to taxation (and that embraces almost everything in Massachusetts except their proprietary interests

in graveyards); and in blanks officially furnished for such purpose there is a special space for a return of every individual's income. If no return is made, then the Board of Assessors meet in secret in an upper room of the City Hall, known as the "Dooming Chamber," and arbitrarily determine the amount of income for which each delinquent shall be assessed; and from such determination there is practically no appeal. The amount thus assessed for income to the individual is then "lumped in" with the aggregate of his other taxes; and if a dissatisfied taxpayer wishes to discover what amount has been decided upon as his income, the assessors will not afford him any information. Under such circumstances it might naturally be supposed that the administration of an income tax in the city of Boston would be an unqualified success. But what are the facts?

First, comparatively few of the taxpayers of Boston make any returns to the assessors of their income. *Second*, the returns that are made are not open to the inspection of the public. There is no law in Massachusetts covering this point, but one of the Boston assessors is reported as saying that if the returns were open to public inspection none would be made, as the chief objection of taxpayers to filing returns was the fear that their incomes from business or professions might be known. The statutes of Massachusetts, however, provide that the returns of each individual's property shall be made by the assessors of every city and town in the State to the secretary of the Commonwealth; but inquiry shows that the Boston assessors make no such returns. *Third*, although the amount annually collected from an income tax in the city of Boston is very considerable—$840,000 in 1892—it probably represents, according to the Boston Advertiser, "only about one fourth of what is due in the city from incomes." In the face of such an exhibit the question is pertinent, What measure of success do the present advocates of a Federal income tax expect will follow an attempt to expand the Boston system of its administration over an area of country extending from Florida to Alaska?

One would naturally think that the lesson of experience which the Government and the people of the United States have already had, would restrain further experimenting with this subject until the next war or the arrival of the millennium.

That a free government can not efficiently collect a tax which its people regard as unjust without a resort to despotic methods that public sentiment in turn will not tolerate is illustrated in this further tax experience of Massachusetts:

The State laws require that citizens who are shareholders in corporations organized in other States shall be taxed in Massachusetts on the market value of shares so held; and such owners are re-

quired to make a return under oath of the amount of such property in their possession.* Yet a petition recently presented to the Legislature of the State by representative members of boards of trade and chambers of commerce recites that the law in question "is ineffective and therefore ridiculous, as is proved by the fact that although the market value of shares of foreign corporations held by citizens of Boston alone is believed to be over $600,000,000, the amount taxed by the assessors of Boston was then only estimated at $45,000,000; and nearly all of this that is known is taxed to the unfortunate people whose estates are in trust." †

In the United States the income tax, as enacted in 1863, exempted $600 annual income for each person, together with whatever was paid annually for rent and repairs of residence. Five per cent per annum was then levied on all incomes above $600 and not in excess of $5,000; seven per cent on all incomes in excess of $10,000. In the income tax of the United States as it existed at one period there was, therefore, recognized the principle not only of exempting incomes below a certain amount from all taxation, which amount, in order to keep up the appearances of equity, was allowed to be equally deducted from all larger incomes; and in addition a further feature, not generally recognized in other existing systems of income taxations, of "graduating" the assessment by increasing the rate or the percentage on the larger incomes; a system most exceptional and peculiar, but which on first presentation seemed to find favor as an ingenious and equitable method of equalizing the burdens of the State between the rich and the poor.

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* The tax laws of New Hampshire and Vermont are drafted especially with a view to compelling the disclosure of income.

† If any one thinks that this extraordinary tax experience is limited to one section of the country, he would do well to acquaint himself with the recent results of the State of Ohio in attempting to tax money on deposit. Ohio has even a more efficient and minute scheme of taxing all classes of property than Massachusetts. Not only is every citizen bound under oath to make a complete return of his property, but the law, in addition, empowers each county in the State to contract with certain so-called "tax inquisitors" for the payment of twenty per cent of all taxes collected through their agency on previously assessed property. How successful this scheme has been in collecting taxes on money on deposit is shown by the fact, revealed in a recent report of the State Board of Tax Commissioners, that while the amount of money on deposit in the State, national, and private banks of Ohio in 1892, and subject to State taxation, was at least $190,000,000, the amount actually returned for taxation in the whole State during that same year was but a little over $32,000,000. There is a remark that has almost assumed the character of a proverb, that a text suitable to and illustrative of every situation may be found in the Bible. The text that is most applicable, and which ought to be full of instruction to every congressional advocate of the enactment of an income tax by the Federal Government in time of peace, will be found in the sixth chapter of the First Epistle of Paul to the Corinthians, where the apostle, as if he had the existing situation in view, remarks, "All things are lawful unto me, but all things are not expedient."

The present is therefore an advantageous opportunity for asking whether any income tax which discriminates in any degree is likely, as is often claimed, to constitute the one perfect form of taxation of the future. And at the outset attention is asked to the following considerations, to which popular attention is not always intelligently given:

A Federal income-tax system necessarily involves multiple taxation on one and the same income, person, and property. For example, in the United States a citizen of any one State would be liable, in the *first* instance, to the Federal tax on his income; *second*, to a State tax on the same income; *third*, to a tax on the property or business producing the income, in virtue of its location and consequent territorial jurisdiction of the State. In some States—Massachusetts, for example—the State, in virtue of its jurisdiction over a person, taxes him also for property beyond its territorial jurisdiction and subject to taxation in the State where it is an actuality. Doubtless such duplications in a greater or less degree will be inevitable in the case of all Federal taxation. But where there are so many sources available to the national Government for obtaining revenue, it would seem to be impolitic for it to encroach on those methods which are particularly applicable to the States—as income taxes, taxes on legacies and successions, which are governed and protected by State laws, and franchises, which are almost exclusively granted by the States and rarely by the Federal Government. Certainly there would seem to be no warrant in either justice or expediency in unnecessarily favoring such a system of multiple taxation; thereby increasing the real or fancied grievances of the people in respect to all taxation, and creating, by reason of a sense of injustice, additional temptations on the part of the taxpayer to fraud and evasion.

Again, all modern systems of income taxation have recognized the principle of discriminating in favor of persons in receipt of comparatively small incomes, and have provided as a fundamental feature of their policy, that all incomes below a certain rate should be exempted from assessment. Such exemptions, except in the case of the United States, have always and until within a recent period been of a comparatively small amount. In Great Britain it is £160 ($800) per annum. No difference is made in England in levying the income tax, though often proposed and advocated, on account of the source whence the income is derived. Whether the income is earned by the exertions of its possessor, or arises from property, so that the recipient is sure of it without the slightest exertion at all on his part, the same proportion has always been deducted from it. In the administration of its income-tax system England has aban-

doned the idea of assessing an income derived from multiple sources as a whole to one taxpayer, and in place divides an assessable income into schedules according to its source; and, in fact, has given to such a system the popular designation of "the stoppage at source plan." Thus at present the sources of income in Great Britain are classified as pertaining to one or more of five schedules—designated as A, B, C, D, and E. For example, the profits or income derived from agricultural industry are classified as under schedule A, and those from manufactures, mines, gas works, and water supplies under schedule D, and the like; and it is only in schedules A and D that the income receiver must make a return of agricultural, mercantile, or manufacturing gains or profits.*

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* A recent number of the London Times reports the following additional illustration of the ingenuity of the people of every country subject to an income tax to evade the payment of the same.

"There is an argument in favor of the separation of the incomes of married couples for the purpose of income tax which has not yet been advanced. It is the immoral state of the law as it stands at present. John and Mary, each possessing incomes of less than £500, but in the aggregate exceeding that sum, agree to live together as a certain 'advanced' couple did who made themselves notorious only a short time since. They are both entitled to relief under the act Should they, however, legalize their union, neither is entitled to any rebate, and they are actually taxed for rendering themselves respectable members of society. And this is in moral England."

In the earliest of Mr. Gladstone's budget speeches, that of 1853, he distinctly refused, while admitting that a great deal might be said in favor of taxing incomes at different rates, according as they proceed from property or from skill, to break up the income tax into classes, and to make a difference in the assessment according to the source from which the income was derived. Mr. Gladstone's argument, in this instance, applied to the difficulty of discriminating between the various degrees of the durability of incomes; but his definite refusal to "vary the rate of the tax according to the source of the income"—on the ground, to use his own words, that "I think that I should be guilty of a high political offense if I attempted it"—may suffice as a sufficient expression of his opinion in favor of a proportional system. In a recent number of the Nineteenth Century Mr. Gladstone referred to his budget of 1853, in which he continued his income tax, and to his proposal, in 1874, to carry on the national finance without its assistance. He refers to the preparations made, through successive reductions of the tax, for its ultimate abolition, and observes that "in 1874, for the first time since 1845, the opportunity arrived. The nation had its opportunity and took its choice. It may have been wise or unwise; but it was made by competent authority. The result is told in our present expenditure."

In general discussions on the income tax, especially those which have characterized the financial debates in the British Parliament, the proposition has been often advanced that it is a hardship that incomes arising from the exertions of a man's brain should be charged at as high a rate as those resulting from invested capital; and during the present Parliament (1896) a motion was made by a leading member that the financial committee of the House may have permission to amend the assessment in such cases. In a debate which followed (instituted by Sir John Lubbock) it was stated that "while there was an immense difference, no doubt, between the two classes of incomes, if extreme cases were considered, they nevertheless passed the one into the other by imperceptible gradations. Nor had any satisfactory treatment of investments ever been suggested. Let them take one class—the securities of foreign nations. Some were excellent, others,

The result of a progressive income tax instituted a few years since in Vaud and other prosperous and populous Swiss cantons is reported to have already verified the predictions and prophecies of the European economists. The project has been often discussed in England, France, and other countries, but the tendency of economic discussion has always been generally adverse to it, on the ground that such forms of taxation would discourage the permanent investment of capital, and encourage capitalists to transfer their capital and business to other and foreign localities. Vaud, however, in particular, determined to ignore the economists and impose the tax, and the inevitable disturbance of capital is reported to have taken place. One of the chief capitalists of Lausanne, a Swiss tanner named Mercier, employing several hundred workmen, is moving his business from Lausanne to the other side of the lake (Geneva) at Evian. Evian is in French territory, and there is no progressive income tax there. "Up to this time," wrote M. Mercier, in a letter published by the Lausanne papers, "I have paid over 20,000 francs a year in state and town taxes. The new law would raise that figure to 80,000 francs or more. I owe it to my family to withdraw out of reach of what I can not consider otherwise than downright spoliation."

A recent economist, commenting on this transaction, thus curtly developed the whole subject: "The fact is that a progressive income tax will not work under modern conditions. The modern movability of capital has made all the difference. The Florentine

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unfortunately, as investors knew to their cost, were almost valueless. An arrangement, however, proposed by Sir Robert Peel in 1858 gave a substantial relief to those who had precarious incomes. They made their returns on an average of the income during the three preceding years, and, if the amount fell short, a rebate was given on the difference. He urged that they might make an effort this year to induce Parliament and the Government to revert to the old system, which, it was evident, would be only fair and a great boon to all those whose income depended upon their own exertions, whether in law, medicine, or commerce." He contended that the rising and successful man was assessed on less than his income, while the man whose income was falling was made to pay on more than his income. The Chancellor of the Exchequer said in reply that "his friend had urged the desirability of returning to the system that existed prior to the passing of the act of 1865. He seemed to have overlooked the fact that the alteration effected by that act, which he now wished to overthrow, was introduced at the express instance of Mr. Hubbard, who was a strong advocate for lightening the burden of the income tax wherever practicable. Taking the average of a man's income for three years was a plan specially devised to meet the difficulty in the way of appeal that would be experienced by business and professional men. He was quite willing to allow that system to continue, as he believed that it was, on the whole, fair to both parties. The proposal of his friend, however, while adhering to the form of making a return upon the average, did not in fact carry out that principle at all, for the first year was only to be struck out where the fourth year showed a loss. Surely, therefore, if the revenue was to collect only on the small receipts, the principle of average ceased at once. For this reason he did not feel justified in accepting the amendment."

democracy taxed capital to death, no doubt, but in the middle ages once a Florentine always a Florentine. Cosmopolitanism was not invented, and a man hesitated long before seeking his fortune among strangers when 'stranger' and 'enemy' were almost equivalent terms. All that is now changed. A progressive income tax in England, unless very moderate and managed with the utmost circumspection—and even then the experiment would be too dangerous to try—would certainly result in an enormous transference of English capital to Belgium and Germany. If the idea of progressive taxation is feasible at all, it is only feasible in the death duties, and even there the difficulties are formidable enough." *

In Germany, the income exemption being very small, nearly the whole population of the country, male and female, are made subject to the provisions of the income tax. According to M. Soetbeer, the German economist, the total income of the classes in Germany who pay income taxes is $2,190,000,000, and of this amount fifty-one per cent is owned by people whose incomes range between two hundred and twenty-five dollars and four hundred and twelve dollars. And the New York Nation surmises that a similar state of things would be found if an analysis of all classes of income-tax payers were to be made in England.

In Austria a new law has been reported by a special Government commission since a previous statement (see Chapter XVIII). At present all persons of Austrian nationality whose annual income exceeds six hundred florins will be liable to a personal income tax,

* The rate of tax progression in Canton Vaud is much less heavy in the case of real than in respect to other descriptions of property. The amount of taxation is fixed yearly. It was for the first year, after the law was passed, at the rate of one hundred and twenty per mille on the lowest class of personal property, with exemptions on movable property, tools, kitchen utensils, clothes, and household furniture. A much more intricate arrangement exists for income derived from personal exertions. Sixteen pounds a year is allowed to be deducted from the income, and exempted from taxation, for the head of the family himself, his wife, for each of his children or descendants who are minors, and for each person for whose maintenance the head of the family is legally liable. Thus, a man with a wife and twelve children, possessing an income of five thousand six hundred francs (two hundred and twenty-four pounds) a year, would be entirely exempt from taxation, as also would be a man with a wife and three children and an income from labor of two thousand francs (eighty pounds) a year. It can not be supposed that a low taxation of this character, with all the risks involved of causing capital to emigrate, and of preventing strangers, who, after an interval, are also to be subject to the same tax, from settling in the canton, or from remaining there, with all the differences of class-feeling which it evoked, could have become law without calling forth some strong and almost passionate expressions. It has to be remembered that besides the taxation for the administration of the canton proper, those levied for the expenses, which we include under the head of local government, such as roads, watercourses, education, free to all classes in Switzerland, and carried out with much vigor and cost, are likewise levied according to the same system. We may form some idea of the weight of the burden thus imposed.

which will be levied on a sliding scale. The scale is graduated so that five per cent will be levied on small incomes and as much as six per cent on large ones. Employees whose total incomes are less than six hundred florins per annum are exempt. In addition to the income tax, persons of either sex trading or carrying on business on their own account are subject to an additional impost. The new law is intended to supersede the existing system by the introduction of a general tax on private trading and industrial establishments of all descriptions, a tax on all joint-stock companies and other enterprises legally bound to publish annual balance sheets, a tax on incomes derived from invested capital, and a personal income tax based on a progressive sliding scale.

In France, the republic, although groaning under an almost overwhelming burden of debt, has recently refused, by a vote in its Chamber of Deputies of 267 to 236, to reconstruct its income-tax system, with a view of increasing the revenue derived from it; and subsequently, by a majority of 289, refused to reconsider its position, although the organic law framed for France in 1875 gives the national legislature unlimited power over taxation, direct as well as indirect. During the popular discussion that preceded this legislative action, it is interesting to note that a progressive income tax was not properly regarded as more oppressive than many other forms of taxation, and as a matter of French experience a heavy income tax—about four per cent—is now levied on French bonds and shares, in fact, on every dividend of a French company, while no income tax is levied on French Government stocks or foreign bonds; and this apparently unfair treatment is accounted for because the revenue derived from French companies can be easily ascertained and the companies made responsible for it, while such a result would be impossible in the case of foreign bonds or foreign stocks and shares, and hence the difficulty has arisen of how to compel the taxpayer to pay: as, if the declaration was left to him, it was not unreasonable to suppose he would not declare it, or only declare it in part; while if left for ascertainment by French officials, it was feared that the income tax in France would become a political weapon, which would be freely used against the legislators in power.

M. Paul-Beaulieu, a distinguished French economist, has recently advanced and advocated the view that a state in instituting an income tax for the sole purpose of obtaining revenue, ought not to grade the tax at all, or lay a higher rate on large incomes than on smaller ones; or, in other words, that it is better to tax all incomes that are taxed at all at one uniform rate; and the reason for this is that the large incomes form so small a percentage of the total that the increased rate adds no great amount to the revenue, while it

greatly increases the difficulty of assessing large incomes at their true value.

In support of this view he submits in general terms the following results of his careful examinations in Prussia, Saxony, and England: In Prussia, where incomes above one hundred dollars were taxed, for the year selected by M. Beaulieu, about one fourth of the people were entirely exempt. Of the rest, thirty-five thirty-sixths paid on incomes of from one hundred dollars to seven hundred and fifty dollars. Only one person out of forty-three had more than seven hundred and fifty dollars income. Only a little over four per cent of the total income of the country belonged to persons having an income of from $4,000 to $20,000, and only 1.7 per cent to those having over $20,000 income.

In Saxony one fifth of the total incomes belonged to persons having less than one hundred and fifteen dollars yearly. The incomes of those having less than four hundred and seventy-five dollars each aggregated about two thirds of the total income. The great incomes, exceeding $25,000 to the person, belonged to seventy-three individuals, and comprised less than one and a half per cent of the total.

In England incomes under one hundred and sixty pounds, or eight hundred dollars, are not taxed. In the year selected by M. Leroy-Beaulieu 381,000 persons paid income taxes of a total of $750,000,000. Of the contributors 342,000, or about nine tenths, paid on incomes of less than $3,000, but it is noticeable that they were taxed on not much more than a third of the total amount. Thus nearly two thirds of the taxable income belonged to 39,000 persons. One fifth of the total incomes assessed belonged to 1,222 persons, with an income of over $50,000 each.

It will be seen that there is a striking difference in the results shown by M. Leroy-Beaulieu's figures in Germany and England. Much of this difference is due to the nature of the laws, by which all small incomes in England are free from taxation, but a part of it is to be attributed to the larger fortunes in England.

Italy.—There is no income tax in Italy in the sense in which that term is used in England and the United States, but there is a so-called professional income tax which was by an old law fixed at seventeen per cent on half the estimated income, and which has been somewhat increased by a new law in which there are variations made according to the sources of income. While Italy is, in fact, potentially one of the richest countries in Europe, and in ancient times was so regarded, its name to a certain extent has come to be synonymous with poverty. The explanation of this is that its government is prodigal and dishonest; and in gathering its income the dishonesty of its officials causes its taxation to fall most oppressively on the

classes which a wise statesmanship would protect, and leaving the minimum burden on those who are most capable of bearing its maximum.

A new feature of the British fiscal system, which in a certain sense may be regarded as an increase of the exemption under the existing income tax, has recently been sanctioned by Parliament under the name of the "Farm Rating Act," which proposes to mitigate existing agricultural depression by relieving farm lands of a large part of their share of local taxation—i. e., as pointed out in debate in the House of Commons, by Sir William Harcourt, "by taking £2,000,000 ($10,000,000) out of the general taxation of the country," inasmuch as, if certain existing sources of revenue supply less, other taxes must supply more. "This will bring up the total governmental contribution for like purposes to £6,000,000 in 1868, and £11,000,000 in 1892." In a debate on this subject before the Royal Statistical Society, it was maintained that an assessment of the English poor rate, to which nearly all other English rates were now mere additions, was originally founded on the principle of ability to pay, and that principle had never been expressly repudiated. But the making of this expenditure a local charge was in itself a negation of the principle of taxation according to ability, and the only question now was whether an attempt to establish in each locality a principle which had been established as regards the nation as a whole. The answer was in the negative.

"Speaking very broadly," wrote Mr. Goschen a quarter of a century ago, "in England fifty years ago land bore two thirds of the taxation on real property, and houses and other property one third; the latter now bears two thirds, while lands bear one third. In France lands bore over two thirds more than fifty years ago, and bear more than two thirds still. Land, in short, is not as a rule highly rated in England, and where it is highly rated what is wanted is a revised assessment."

What is Exemption from Taxation?—An exemption is freedom from a burden or service to which others are liable; but an exemption for a public purpose, or a valid consideration, is not an exemption except in name, for the valid and full consideration, or the public purpose promoted, is received in lieu of the tax. Nor is an exemption from taxation a discriminating burden on those who pay an income tax, provided the person or institution benefited by the exemption is a pauper, or a public charitable institution; for then there is consideration for the exemption, and it is justified as a matter of economy, and to prevent an expensive circuity of action in levying the tax with the sole purpose of giving it back to the intended beneficiary of the Government. The avoidance of this unnecessary

circuity of action is not, moreover, an injury but a gain to those who pay the tax. It can not, however, be seriously claimed that a man having $100,000 dollars of productive capital, and receiving from it $4,000 of annual income, is entitled to receive support from the Government as a public pauper.

An income tax which permits of *any exemption whatever* is a graduated income tax, not by the rate of the tax but by the amount of the exemption, because all incomes below an arbitrary line are entirely exempt from the tax. Again, in treating of an income tax it should be always borne in mind that, when a Government taxes the *income of property*, it in reality taxes the property from which the income is derived. In England and on the Continent of Europe land is taxed on its yearly revenue, or income value, and these taxes are always considered as land taxes. Alexander Hamilton, in discussing the taxation of incomes derived directly from property, used this language: "What, in fact, is property but a fiction, without the beneficial use of it? In many instances, indeed, the income is the property itself." (Hamilton's Works, vol. iii, p. 523.)

As in theory all citizens ought to contribute in proportion to their revenue to the support of the Government under which they have chosen to live and to which they look for protection in respect to their persons and property, the exemption of any from an income tax can only be justified on the assumption of the non-receipt by the citizen of an income beyond what is necessary to defray the expenses of a moderate living. In truth, any exemption under a general income tax is in principle an act of charity on the part of the Government. It is interesting, therefore, to note where the authors or special advocates of the income tax of 1884 proposed to draw the line in respect to charity and as to the amount of property the possession or enjoyment of which, in their opinion, constituted riches.

If the law exempts from taxation income from property to the extent of $2,000, it in effect exempts property to the capital value of $50,000 from taxation, for at present *four* per cent is about the average profit of money, land, or other property, over and above all charges and taxes, and at that rate of profit $2,000 will be the annual income value of $50,000. If, however, we asssume five per cent as about the present annual average profit on money, land, or other property in the United States, over and above all charges and taxes, then an exemption of $4,000, the rate fixed upon in the income-tax act of 1884, would represent an accumulation, or business, or profession, of the value of $80,000. If we take the rate at which the United States can borrow money—namely, three per cent—then an exemption of $4,000 would represent an accumulation of a citizen, invested in United States securities, of

$133,333+. And, according to any fair interpretation of the action of the committee which reported in 1884 a $4,000 exemption, a citizen who is worth less than $80,000 of ordinary property yielding income, or $133,000 of property invested in United States bonds, was a legitimate object for national charity; the above sums representing the dividing line in the United States between those who were entitled to be regarded as poor and those who were entitled to be considered rich. Such an assumption finds no precedent in fiscal history, and was an unwarranted favoritism to nine tenths of the well-to-do people of the country, who were abundantly able to pay any just proportion of the taxes which the Government then considered it necessary to impose for its support. Under such circumstances it would be a misnomer to call such an extortion taxation. It was unmasked confiscation and a burlesque on taxation. In the case of the income tax of 1868, when the amount of exemption was $1,000, experience demonstrated that more than nine tenths of the entire property of the country, and more than ninety-nine hundredths of its property owners, escaped payment from this form of taxation.

Again, an income tax which exempts $4,000 of income in the United States can not be defended by any rational rule or doctrine, legal or economic, for the property and income exempted would be infinitely greater in the aggregate than the property and the income of the same class made subject to the tax. Under this form of an income tax there could be no equality between taxed-producers and non-taxed-producers, and more especially as the non-taxed-producers will be the most numerous and the greatest producers in quantity as a body.

No man is a freeman whose industry and capital are subject to exaction, and from which his immediate competitors are entirely exempt. Equality of taxation of all persons and property brought into open competition under like circumstances is necessary to produce equality of condition for all, in all production and in all the enjoyments of life, liberty, and property; and government, whatever name it may assume, is a despotism, and commits acts of flagrant spoliation, if it grants exemption or exacts a greater or less rate of tax from one man than from another man, on account of the one owning or having in his possession more or less of the same class of property which is subject to the tax. If it were proposed to levy a tax of five per cent on annual incomes below $4,000 in amount, and exempt all incomes above this sum, the unequal and discriminating character of the exemption would be at once apparent; and yet an income tax exempting all incomes below $4,000 is equally unjust and discriminating. In either case the exemption can not be founded or

defended on any sound principles of free constitutional government; and is simply a manifestation of tyrannical power, under whatever form of government it may be enforced. The great republican principle of equality before the law, and constitutional law itself, alike preclude any exemption of income derived from like property.

M. Thiers, in his work on the Rights of Property, thus forcibly condemns confiscation under the name or form of a graduated income tax: "Proportionality," he says, "is a principle, but progression is a hateful despotism. . . . To exact a tenth from one, a fifth from another, and a third from another is pure despotism—it is robbery."

Finally, the principle involved in this question of discriminating income taxation is one that affects the foundation and continued existence of every free government—namely, the equality of all men before the law. Any exemption whatever, under an income tax, be it small or great, except to the absolutely indigent, is purely arbitrary; and the principle once allowed may be carried to any extent. Any exemption of any portion of the same class of property or incomes is an act of charity which every patriotic American citizen ought to reject upon principle and with scorn, except under circumstances of great want and destitution. Equality and manhood, therefore, demand and require uniformity of burden in whatever is the subject of taxation.

THE INCEPTION OR ORIGIN OF THE INCOME TAX IN THE UNITED STATES.—The subject of taxation in the new Government which it was proposed to establish in place of the colonial system which the Revolution had supplanted, constituted one of the most important and salient points of interest in the convention which framed the Constitution of the United States, and was the cause of much difference of opinion among its members and earnest contention between the States. The great source of weakness of the Confederation was its inability to levy taxes of any kind for the support of its Government. To raise revenue it was obliged to make requisitions upon the States which were respected or disregarded at their pleasure. Great embarrassments followed the consequent inability to obtain the necessary funds to carry on the Government. One of the principal objects of the proposed new Government was to obviate this defect of the Confederacy by conferring authority upon the new Government by which taxes could be directly laid whenever desired. Great difficulty in accomplishing this object was found to exist. The seaboard States were unwilling to give up their right to lay duties upon imports, which were their chief source of revenue. The inland States, on the other hand, were unwilling to make any agreement for the levying of taxes directly upon real and personal property, the

smaller States fearing that they would be overborne by unequal burdens forced upon them by the action of the larger States. In this condition of things great embarrassment was felt by the members of the convention. It was feared at times that the effort to form a new Government would fail. But happily a compromise was effected by an agreement that direct taxes should be levied by Congress by *apportioning them among the States according to their representation.* In return for this concession by some of the States, the other States bordering on navigable waters consented to relinquish to the new Government the control of duties, imposts, and excises, and the regulation of commerce, with the condition that the duties, imposts, and excises should be *uniform throughout the United States;* so that, on the one hand, anything like oppression or undue advantage of any one State over the others would be prevented by the apportionment of the direct taxes among the States according to their representation; and, on the other hand, anything like oppression or hardship in the levying of duties, imposts, and excises would be avoided by the provision that they should be uniform throughout the United States.

The Federal Constitution accordingly upon completion divided the taxes that Congress might impose under it into two classes: those which are *direct* and those which are *indirect,* or, as the letter of the Constitution expresses it, "duties, imposts, and excises." It also provides that the former shall be apportioned, equally with representation in Congress, among the several States of the Union, according to their respective numbers, that "no capitation or direct taxes shall be laid unless in proportion to the census"; and that the latter class of taxes shall be "uniform throughout the United States."

But from the beginning of the Federal Government the determination of the exact legal meaning of the word "direct" as applied in the Constitution to taxation has been one of great difficulty and embarrassment, although the doctrine in England and her colonies, before the adoption of the Constitution, was a favorite one, that "taxation and representation should go together." *

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* The framers of the Constitution intended that the apportionment of direct taxes among the States should be in more exact ratio to the population even than it is possible to apportion the representation. For example: Suppose one representative to every ninety thousand inhabitants, a State might have a large fraction left over; but the apportionment of direct taxes was designed to be with mathematical accuracy to the precise number of persons ascertained by the census. After the first apportionment of representatives had been made in the Federal Convention by estimated population, before an actual census, it was held that the estimate of the population of the different States was not sufficiently accurate for the apportionment of a direct tax; and that, consequently, the General Government could not lay a direct tax until a census should have been taken. Elbridge Gerry, of Massachusetts, moved that until a census be taken direct taxation be apportioned to the

In almost one of the first cases that came before the United States Supreme Court after the adoption of the Constitution it was decided that a tax on carriages, the payment of which was resisted by one Hylton, of Virginia, on the ground that such a tax was a direct tax, and had not been apportioned among the States as required by the Constitution, the court held that the tax in question was to be considered as a tax on the expenses of living and not a direct tax within

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number of representatives. Mr. Carroll, of Maryland, replied that "*the number of representatives did not admit of a proportion exact enough for a rule of taxation*" (Elliot's Debates, v, 451). Mr. Ellsworth "thought such a rule unjust. There was a great difference between the number of inhabitants, as a rule, in this case. Even if the former were proportioned as nearly as possible to the latter, it would be a very inaccurate rule. A State might have one representative only, that had inhabitants enough for one and a half or more, if fractions could be applied" (ibid., 453). Mr. Gerry's motion was defeated. The convention, after debate, *decided that direct taxes must be apportioned in the States in more exact ratio to the population than the representatives could possibly be apportioned* (Elliot, v, 453).

Many of the leading patriots of the Revolution—Patrick Henry among them—were distrustful of granting this power, even with the restriction placed upon its exercise. Massachusetts accompanied her adoption of the Constitution with a resolution, signed by John Hancock, recommending an amendment of the Constitution which should prohibit Congress from levying a direct tax until they should first have made a requisition on the States (I Elliot, 323). The same amendment, word for word, was recommended by the State of New York and the State of North Carolina, and similar resolutions were adopted by South Carolina, Rhode Island, and Virginia.

In the apportionment of the direct taxes which had been laid by Congress previous to the income tax the ratio to the census was preserved with scrupulous accuracy, and the actual use of the authority up to the time of the imposition of the income tax was in accordance with the understanding of the framers of the Constitution.

Mr. Madison, who was probably the most active participant and member in the convention that framed the Constitution of the United States, in a letter written after the adoption of the Constitution but before the organization of the new Government, and never discovered (by Mr. Worthington Ford) and its contents made public until 1895, embodies much new information in regard to the intent and purpose of the term "*direct*" taxes as used in the Constitution and in regard to the understanding of the people of the United States concerning that term when they adopted the Constitution. It shows, what is extraordinary, "that the term, in the estimation of the men who used it, did not refer to the kind, or character, or nature of the tax itself, and that the framers of the Constitution never considered the subject of taxation from the philosophical or politico-economic point of view, but were wrestling with the stern necessities of the question, How shall the people of these several States be induced to pay a Federal tax?

"Manifestly, it could be raised by but one of two methods: either *indirectly*, by 'requisitions' on the several States, as under the still existing Confederacy, or by taxes laid *directly* by the Federal Government. Duties and excises were not indirect taxes; they were not under discussion or consideration; they were not in the case at all. *Indirect taxes* were taxes procured indirectly by 'requisitions' on the States; *direct taxes* were taxes laid *directly* by the Federal Government. The framers of the Constitution evidently had never looked at the subject from a politico-economic point of view; they had never given a thought to the philosophy of taxation; the term 'direct taxes,' as they used it, did not refer to the kind or character or nature of the tax, but to the fact that such taxes were no longer to be laid indirectly through 'requisitions' upon the States, but directly upon the taxpayer by the newly constituted taxing power. Indirect taxes would be a thing of the past, of the

the meaning of the Constitution, as the evils which would attend its apportionment according to population would be so great "that the Constitution could not have intended that an apportionment should be made."

On the other hand, when a citizen of Illinois—Hon. William M. Springer—resisted, in 1880, the payment of a national income tax on the ground that such a tax was a direct tax, and, not being levied in the proportional manner presented by the Constitution, was not legal, the court decided that "direct taxes, within the meaning of the Constitution, are only capitation (head) taxes, and taxes on real estate; and that the tax of which the plaintiff complains (i. e., a direct tax) is within the category of an excise or duty."

If, now, it had been clear and certain as to the exact meaning that the framers of the Constitution intended to apply to the word *direct* when they used it in connection in former years with prospective Federal taxation, the cases referred to would never have begun. But they left no clear and certain expression of opinion on this subject, and it was doubtful if they collectively ever had one. On this point the evidence of Hamilton is conclusive; for in his legal brief in the carriage case, in which he appeared as counsel for the Government, he says: "What is the distinction between direct and indirect taxes? It is a matter of regret that terms so uncertain and vague on so important a point are to be found in the Constitution. We shall seek in vain for any antecedent settled legal meaning to the respective terms. We shall be as much at a loss to find any distinction of either which can satisfactorily determine the point." But it is to be further noted that in his argument in behalf of the Government in the carriage case, Hamilton mentioned as taxes which were to be considered, capitation (poll) taxes, taxes on land and buildings, and general assessments. (See his brief in the case referred to.)

All historical data explanatory of the constitutional meaning of the term "direct" have accordingly been of an indirect character, and so imperfect that the court has heretofore apparently not regarded them as worthy of consideration. But this condition of

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expiring Confederation; taxes directly laid by the future Government would supply its extraordinary revenue when needed.

"But here State jealousy had entered into the problem which the framers were solving—the difficult problem of taking power from the individual States and transferring it to this new, unknown, and distant central authority. If Congress could lay a tax directly upon the property of the citizens of all the States, might it not be so laid that the citizens of Virginia would have to pay more than the citizens of New York? How should the power so transferred be restrained?

"The convention answered the question by the word population. The new power of direct taxation should be given to Congress, *but the system of quotas*, with which the people of the country were familiar, *should be retained*."—*New York Nation*.

things no longer exists; for in the brief submitted to, and in the argument made before the United States Supreme Court adverse to the constitutionality of the provisions of the income-tax enactment of August, 1894, by Hon. Clarence A. Seward, a department of national history which no historian or jurist had ever before completely exploited, was so traversed by him that it is difficult to see how any one can acquaint himself with its results and doubt that, although the framers of the Constitution and the people they represented might not fully agree as to a full and comprehensive definition of a direct tax, there was apparently a perfect unanimity of opinion among them that an income tax was a typical example of that kind of taxation.

Previous to the adoption of the Constitution there were no Federal taxes, and all precedents for helping to a correct determination of the constitutional meaning of direct taxation must therefore be drawn from the prior experience of the several States.

What was that experience? Recent historical research shows that Massachusetts had taxed incomes for more than a hundred years prior to the assembling of the Constitutional Convention; other of the leading States were imposing like taxes at or about 1787, and the receipts therefrom were used to help pay the quotas demanded by the then Government of the Confederation for the maintenance of the Federal Government. The income tax so paid, and all the other internal taxes collected by the States, were known as and called direct taxes and are so called to-day.

The Constitutional Convention empowered Congress to levy any of the authorized forms of taxation on the States; but the levy of direct taxes was guarded by a provision that such taxes should be apportioned to the population. The explanation of this curious anomaly is that the consensus of opinion in the convention was that wealth at that period was so equitably divided among the people of the States that population was the best measure of wealth and consequently of equitable taxation. But what would become of the element of equality if the levy was in the form of indirect taxes—duties, imposts, and excises—which, falling on the consumption of tea, coffee, sugar, spirits, and the like, leave it optional with the citizen in a great degree whether he will pay or not? Hamilton certainly thought that the door had been effectually closed against the possibility of any such evasion, for, when speaking of direct taxes in The Federalist, he says: "An actual census or enumeration of the people must furnish the rule; a circumstance which effectually shuts the door to partiality or evasion."

But any doubt on this subject ought no longer to be tolerated, for we now have, almost for the first time, a definition of or distinc-

tion between direct and indirect taxes that is founded on sound philosophy and large experience, and can not be refuted—namely, a direct tax has always in it an element of compulsion. The person against whom or on whose property or income a direct tax is levied has no option whether or when he shall pay. There is nothing voluntary about it. On the other hand, an indirect tax, whoever may first advance it, is paid voluntarily, and primarily by the consumer of the taxed article.

But the most important and vital issue involved in the income tax enacted 1894 (August 18th) was that it designedly provided for discriminating taxation, and this fact may be best demonstrated and brought to popular comprehension in the following manner: In a recent interview (1885) with a leading British parliamentary authority, the conversation turned on the new and unprecedented discriminating rates in the legacy and succession taxes imposed by the present British Parliament, and the opinion of the writer was asked respecting them. He returned, offhand, the answer that he could only discuss them from a British point of view, for, under the Constitution of the United States, such taxes could not be levied by the Federal Government, contemporaneously, and how promptly foreign authorities recognize the truth of this position is shown by the following extract from an editorial in the London Times on the phase of the income statute then before the United States Supreme Court: "Were we," it said, "under the United States Constitution, Sir William Harcourt's budget would have been declared unconstitutional. Populist leaders in America must envy us the freedom of dealing with other people's property, enjoyed in this motherland of liberty." This conversation led to a historical investigation, and the recognition of what seemed to be a fact little or not before noted, that the United States is the only nation that now exists or ever has existed which, through constitutional or other provisions, has, or has had, any limitations on its Government in respect to the general exercise or extent of the power of taxation. If there are any exceptions, they are to be found in the legislative enactments of the French National Assembly of 1789, and possibly in what is now known as the referendum system of Switzerland.

But a government that has no limitations on its power of taxation, that can arbitrarily take in whatever manner, to whatever extent, and at whatever time it pleases, the property of its people or subjects, whether that right exists in theory, as in England, or in actual practice, as in Germany, Austria, and Russia, is a despotism. If this assumption and reasoning may seem to any one extravagant and unwarranted, his attention is respectfully asked to the following expression of opinion on this subject by the United States Supreme

Court, as given through Justice Miller in the celebrated "Loan Association *vs.* Topeka" case (20 Wallace, 665):

"*It must be conceded that there are rights in every free government beyond the control of the State. A government which recognized no such rights, which held the lives, the liberty, and the property of its citizens subject at all times to the absolute disposition and unbounded control of even the most democratic depository of power, is after all but a despotism. It is true it is a despotism of the many—of the majority, if you choose to call it so—but it is none the less a despotism.*"

And yet can there be any doubt that the American people would have abandoned its proud historical position if the Supreme Court had decided in 1885 that the income-tax enactment of 1894 was constitutional?

For such a decision would practically have removed any constitutional limitation on the exercise of the power of taxation by Congress, and in this way: First, by establishing that an income tax is not a direct tax, there can be practically thereafter no direct taxes to which the constitutional mandate of apportionment will apply, for popular sentiment will never sanction the enactment of a general "capitation" or "poll" tax, or a direct tax on land.

Then it certainly could not be unconstitutional to multiply classes for taxation according to wealth and increase the rate up to the point of confiscation. Can any one, furthermore, doubt that the primary object of the enactment proposed in 1889 was not the raising of revenue for the national Treasury, but rather to permit a part of the people of the country to impose discriminating taxes on the people of another part, and then fixing a general exemption at so high a rate that those of the first part, who are entirely able, should not be required to pay anything? If this exemption, in place of $4,000, had been fixed only to include the average annual wages or earnings of the working masses of the country, is it probable that Congress would have even considered the enactment of the income tax of 1884? Even before the form of the statute of 1884 was reported from the proper committee, speculation was indulged in to the effect that the constituents of certain districts would not have to pay anything in the way of income taxes under it. That the Government also practically conceded that the income-tax enactment of 1884 was pre-eminently class legislation is also evident from the following extract from a statement made in a brief by the Attorney General of the United States pending the consideration of the income-tax question by the United States Supreme Court: *

* By an enactment of Congress, August 18, 1894, establishing an income tax for the United States, a tax of *two* per cent was imposed on the gains, profits, and incomes of

"Congress," he said, "has adopted as the *minimum* income for the purpose of taxation the limit of four thousand dollars. This limit may be said to divide the *upper* from the *lower middle class*, financially speaking, in the larger cities, or to divide the *middle class* from the wealthy in the country districts." (Opening argument by William D. Guthrie, in support of the contention that the income-tax law of 1894 was unconstitutional.)

Attention is next asked to what seems to be by far the most serious point in this whole matter, and which has not as yet attracted public attention in any marked degree. The American people have been trying an experiment as a nation which has never before been attempted by any other nation—namely, that of universal suffrage, by which the power to elect legislators and shape the policy of the Government has been put under the control of those who, through no fault of their own, have not enjoyed such educational facilities as will enable them independently to form correct opinions on great constitutional, legal, financial, or economic questions, thereby creating almost endless possibilities for injudicious legislation. How such possibilities were being made actualities in the case of the income-tax statute of 1894 can be made evident to almost any one who makes himself fully acquainted with the circumstances attendant on its inception and almost concurrent legal adjudications and contentions.

The members of the convention that framed the Constitution of the United States had the very questions before them that have already been in issue before the American people, and may at no distant day be again presented for their serious consideration. It was inequalities in methods and facilities for the raising of revenue among the States of the Confederation for the support of the Federal Government that threatened the existence of the Confederation and necessitated the assemblage of the Constitutional Convention. And the members of this convention, taught by experience, incorporated in their work the provisions respecting the exercise of the power of taxation, the meaning and validity of which are now called in question. And in so doing they gave to the people of the United States an instrument of which one great feature, if not its chief feature, and one not recognized as it ought to be, is that it guards the rights of minorities as no other governmental instrument devised by mortal

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persons derived from any kind of property, including rent and the growth and produce of lands, and profits made upon the sale of land if purchased within two years. Every element that could make real or personal property a source of value to an owner was taxed. An excise duty was also imposed upon income derived from any profession, trade, employment, or avocation. The tax upon persons generally was not upon their entire income, but on the excess over and above the sum of four thousand dollars. All persons having incomes of four thousand dollars or under were exempt.

man ever has done. As long as this great feature is preserved intact and the nation adds to it another principle, that every question of doubt concerning it shall be always determined in a way to strengthen it, the perpetuity of the present Government is assured. But if now the Supreme Court invalidates this great feature by nullifying the mandate of the Constitution, and thereby practically removes all limitations on the power of Congress to impose taxes, sanctions discriminating taxation and disregards the rights of minorities, the hour when this Government enters upon the path of decadence will have struck. How puerile it is for any one to favor such a decision and its inevitable results, on the ground that a contrary decision would oblige the Government to repay to the people a large sum of money that it had illegally collected from them! This would, however, have one recommendation—namely, that it would approximately solve the difficult question, How much, in terms of money, is the existing Government worth?

Conclusion.—The following extract, incorporated by Mr. Justice Field in his opinion, delivered in concurrence with a majority of his colleagues, and adverse to the constitutionality of the income-tax statute of 1884, which imposed discriminating taxes on the American people, is also pre-eminently worthy of notice in connection with any general history or review of this great subject:

"Here I close. I could not say less in view of questions of such gravity that go down to the very foundation of the Government. If the provisions of the Constitution can be set aside by an act of Congress, where is the course of usurpation to end? The present assault upon capital is but the beginning. It will be but the stepping-stone to others, larger and more sweeping, till our political contests will become a war of the poor against the rich—a war constantly growing in intensity and bitterness. 'If the court sanctions the power of discriminating taxation, and nullifies the uniformity mandate of the Constitution,' as said by one who has been all his life a student of our institutions, 'it will mark the hour when the sure decadence of our present Government will commence.' If the purely arbitrary limitation of four thousand dollars in the present law can be sustained, none having less than that amount of property being assessed or taxed for the support of the Government, the limitation of future Congresses may be fixed at a much larger sum, at five or ten or twenty thousand dollars, parties possessing that amount alone being bound to bear the burdens of government; or the limitation may be designated at such an amount as a board of walking delegates may deem necessary. There is no safety in allowing the limitation to be adjusted except in strict compliance with the mandates of the Constitution which require its taxation to be uniform in operation and, so far as

practicable, in proportion to their property, equal upon all citizens. Unless the rule of the Constitution governs, a majority may fix the limitation at such rate as will not include any of their own number.

"Cooley, in his Treatise on Taxation (second edition, 215), justly observes that 'it is difficult to conceive of a justifiable exemption law which should select single individuals or corporations, or single articles of property, and, taking them out of the class to which they belong, make them the subject of capricious legislative favor. Such favoritism could make no pretense to equality; it would lack the substance of legitimate tax legislation.'

"The income-tax law under consideration is marked by discriminating features which affect the whole law. It discriminates between those who receive an income of four thousand dollars and those who do not. It thus vitiates, in my judgment, by this arbitrary discrimination, the whole legislation. Hamilton says in one of his papers (The Continentalist): 'The genius of liberty repudiates everything arbitrary in taxation. It exacts that every man, by a definite and general rule, shall know what proportion of his property the State demands. Whatever liberty we may boast of in theory, it can not exist in fact while [arbitrary] assessments continue.' (1 Hamilton's Works, edition 1885, 270.) The legislation, in the discrimination it makes, is class legislation. Whenever a distinction is made in the burdens a law imposes or in the benefits it confers on any citizens by reason of their birth, or wealth, or religion, it is class legislation, and leads inevitably to oppression and abuses, and to general unrest and disturbance in society. It was hoped and believed that the great amendments to the Constitution which followed the late civil war had rendered such legislation impossible for all future time. But the objectionable legislation reappears in the act under consideration. It is the same in essential character as that of the English income statute of 1691, which taxed Protestants at a certain rate, Catholics, as a class, at double the rate of Protestants, and Jews at another and separate rate. Under wise and constitutional legislation every citizen should contribute his proportion, however small the sum, to the support of the Government, and it is no kindness to urge any of our citizens to escape from that obligation. If he contributes the smallest mite of his earnings to that purpose he will have a greater regard for the Government and more self-respect for himself, feeling that, though he is poor in fact, he is not a pauper of his Government. And it is to be hoped that, whatever woes and embarrassments may betide our people, they may never lose their manliness and self-respect. Those qualities preserved, they will ultimately triumph over all reverses of fortune."

GERARDE AND THE GERARDIAS: THE HERBALIST AND HIS NAMESAKES.

By MARTHA BOCKÉE FLINT.

ON shaded hillsides and in woodland glades there blooms through August, a stately plant, the most beautiful of a varied group which, as the genus *Gerardia*, perpetuates a name too little honored. Few men have done more for English botany than the "diligent and paineful apothecary," John Gerarde, some time gardener to Cecil, Lord Burleigh. It is just three hundred years since, in December, 1597, was published The Herball, or Generall Historie of Plantes Gathered by John Gerarde of London, Master in Chirurgerie. The second edition thereof, the only copy known to be in the city of New York, is "very much enlarged and amended by Thomas Johnson, Citizen and Apothecary," and bears the imprint "London, printed by Adam Islip, Joice Norton and Richard Whitaker, anno 1633." On the frontispiece of the thick folio is Gerarde's title, given above, inscribed upon an oval supported by Corinthian columns, and bordered by six woodcuts. At the head of the page is represented the sun bursting through clouds, and on its disk is a triangle bearing a Hebrew legend; below are the words from Genesis: "*Ecce dedi vobis omnes herbas semen tantes semen quæ sunt.*" In the upper corners are figures of Ceres and of Pomona, offering grains and fruits. At the left of the columns stands Theophrastus, a scroll in one hand, in the other flowers; at the right, Dioscorides holds an open book. Beneath the title is the portrait of Gerarde, supported on either side by vases heaped high with pyramidal masses of fruits and flowers. The face is the serious countenance of the sixteenth century: oval, with a pointed beard; a long, straight nose, well-arched eyebrows, and deep-set eyes, fixed, as if looking into the hidden mystery of life:

> "Little flower, but if I could understand
> What you are, root and all, and all in all,
> I should know what God and man is."

It is a sad face, but with the serenity of a meditative mind. He wears the quilled ruff and the embroidered doublet of the period, and holds in his hand a spray—perhaps of wild rose. Here is not the exactness which marks Gerarde's own drawings.

The book is dedicated to "The right Honourable, his Singular good Lord and Master, Sir William Cecil," and is written from his "House at Holborn within the Suburbs of London, this first of December, 1597." Holborn—named from Old Bourne, a branch of the Fleet—was itself a rural region which then afforded a fair field

for the collector. Years later, Sir Henry Wotton could say, "I know all the plants of my time, and have scarcely simpled farther than Cheapside." In Gerarde's day wild flowers grew all over London; the water violet was found at Lambeth; "a field at Southwark, back of the theatre," the Globe Theatre, was all abloom; wall rue grew on Westminster Abbey, and wall pennywort over "the door that leadeth from Chaucer's tomb to the old Palace," while bugloss mantled "the drie ditch banks in Pickedille." In "An Address to the well Affected Reader and Peruser of this Booke," he says, "Myselfe, one of the least among many, have presumed to set forth vnto the view of the world, the first fruits of my owne Labours." But he was meanwhile "constrained to seeke after his living, being void of friends to beare some parte of the burden." He further notes the difficulties which beset an honest searcher after truth, saying, "Let a man excell neuer so much in any excellent knowledge, neuer the les many times he is not so much regarded as a Iester, a Booster, a Quacksaluer, or Mountebank."

Gerarde was born at Namptwich in Cheshire, in the year 1545. Thence he came early to London, and both as gardener in the lordly domains of Cecil and as an apothecary, he made wise use of the knowledge gained as "a paineful Herbarist" and "a curious searcher of simples." He studied surgery, and practiced to some extent in the empirical methods of the time, but his heart was centered in his garden at Holborn. There was his seminary, or "seed plot and nursery for young plants," as the word is defined in Bailey's Dictionary. There he collected the English flora, and established many foreign plants, studying their habits, their possible uses, and their adaptation to the climate of England. His diligence in searching out new species was unwearied. Drayton alludes to his work as the limit of possible accomplishment:

> "To those unnumbered sorts of simples here that grew,
> Which justly to set down even Dodon short doth fall,
> Nor skillful Gerard yet shall ever find them all."

Botanists of to-day say that Gerarde knew little of science, but it is worth while to consider what science was in the sixteenth century, when the glamour of alchemy and of astrology diffused a false light over every department of natural philosophy. Gerarde died in 1607, just one hundred years before Linnæus was born, and a dozen years before the birth of John Ray, who laid the corner stone of the natural system and made the first formal catalogue of British plants. For a man then to have studied in any spirit of careful observation means much. His belittlers emphasize Gerarde's ignorance of the classic writers on botany. He might be none the worse for that, but he quotes with discrimination from Theophrastus and

Dioscorides, from Pliny and Galen, and from his contemporaries, Gesner and Fuchsius and Lonicerus. His classification was based on Dr. Priest's translation of Dodoneus, published in 1583, but in the details of arrangement he more closely followed Lobel.

His special excellence was in the careful enumeration of native plants, in the loving study of their properties, real or imagined, and in the vivid descriptions which, with his faithful drawings of English plants, make him an authority in cases of disputed nomenclature. Other cuts in the Herball are from the *Kreuterbuch* of Tabernæmontanus, published at Frankfort in 1588, and used by Dodoneus, by Lobel, and by Clusius.

He delights also in the old English names of plants, and one reads of goldes and of paigles, of pawnce and of floramour, as on a page of Chaucer or of Spenser. Much of the best poetry of plant lore is found in the unconscious charm of his writing. Through it all runs the current of conscientious adherence to truth as he could best discover it. His most marvelous ascriptions of "vertue" to any plant, if not tested by himself, are qualified by "I have heard it reported." He denounces all "ridiculous tales, whether of old wives or some runnagate surgeons and physicke-mongers," and is slow to accept mere hearsay. With every plant he treats in a separate section "The Kindes," "The Description," "The Places," "The Names," "The Temperatures," and "The Vertues" of each. He mentions those which "doe grow in my Garden" with especial tenderness, and one can almost hear the sigh with which he sometimes confesses, "this, I have not seene."

The American genus of the family *Scrophulariaceæ* which bears the name of *Gerardia* includes two groups of plants, related in structure, but very different in appearance. The false foxgloves are stout herbs, the various species from two to five feet in height. In some, the reddish stems are covered with the blue bloom of raspberry briers. In others, the glaucous growth is replaced by a delicate pubescence. The leaves, sinuate or pinnatifid, are thick and usually a bluish green, although in *Gerardia pedicularia* they are thin, pale green, and downy, and in the southern *Gerardia pectinata* they are decidedly hairy. The exquisite yellow of the flowers is the very tint of the butterflies, at their blooming, hovering in thousands over the country roads. The corollas are more open than those of the English foxglove, to which it has little resemblance, and the flaring flowers would furnish better hats than gloves for the little folk in green. Indeed, this etymology of the common name of the *Digitalis* may well be questioned. So careful a student of plant lore as Hilderic Friend says "fox" is not a corruption of "folk," but that the name was probably first fox-gleow—*gleow*,

equivalent to glee or music—its spire of bell-shaped flowers rising above the covert of fox and hare, suggesting the old tintinnabulum, a chime of small bells fixed on an arched support.

The other group of the Gerardias seldom exceeds a foot in height; the foliage is scant, often filiform, and the flowers are open bells of a purplish pink, very gay when blooming profusely on sandy barrens. The one group are the plants of rich woodlands, the other of thin, arid soil, of salt marshes, and of the seashore, but each one records the name of John Gerarde as he would have best liked it to be preserved. Never within his loved garden at Holborn, they are still a fitting memorial of him who so carefully studied their kindred, and

"Kydst the hidden kindes of many a weede."

THE PSYCHOLOGICAL CAUSE OF LAUGHTER.

By M. CAMILLE MÉLLINAND.

WE laugh under the most diverse circumstances. Curious incidents of the most various character, some absurdly trifling and others rising into different degrees of importance, will provoke the feeling that prompts laughter, or the emotion of the ludicrous; for it is this with which we have to do, rather than with the audible explosion. Our inquiry is into the interior cause, into the moral element in the incident that provokes the feeling, and into what takes place in the nervous centers. The study of this is important, and has been well prosecuted by recent authors of the day, but the purely psychological element should not be neglected.

At the beginning of our inquiry we meet the common opinion that the feeling of laughter is caused by joy. This has the merit of simplicity; but joy does not always make us laugh, for there are serious joys; and we frequently laugh without being joyful, and even sometimes at things that are sad.

Another opinion, to which Darwin inclines, is that laughter is provoked by what is queer, unusual, by what disagrees with or is contrary to our mental habits, or interrupts the familiar course. The queer, the old-fashioned, the provincial, partake, we admit, of the ludicrous. Caricatures amuse because of their exaggerations of proportions in contradiction to all natural laws. We recognize that there is something queer in everything that excites laughter, and that no word, act, situation, or attitude can be really laughable without having something strange about it.

Yet the queer does not always make us laugh. There are things contrary to the normal order that have nothing ludicrous about

them; and if the view were true that queerness is the laughable element, those things that are strangest and most unusual should be the very ones most certain by their very nature to excite laughter. But we do not laugh at the dancing horses, the jumping pigs, the musicians playing on bottles, of the circus, all of which are most contradictory of what we are accustomed to. If we laugh at the circus, it is at the accessory jokes and incidents in the detail.

A conjuror's tricks, seemingly contradictory as they are of all our experiences and notions, do not make us laugh. We laugh at his jokes and his funny ways of proceeding, but wonder at the tricks.

In a theory proposed by M. Penjou in the *Revue philosophique*, laughter is excited by whatever appears as free and exempt from law, and as produced by a playful activity or the capricious manifestation of an unrestrained will, as in jokes, plays on words, equivocations, a schoolboy's pranks, deformities, or freaks of Nature. "The same cause of laughter," he says, "will be found in all the cases I can cite. . . . They always involve, under a thousand shadings, the sudden manifestation of a freedom that destroys our prepossessions, but without harm to us or real injury to others. However we may regard it, it is always this abrupt spontaneous outburst, with the entire absence of ostensible cause, that makes us laugh. . . . Spontaneity or liberty makes us laugh, and is, in fact, the essence of the amusing and the ludicrous in all their forms; and laughter is simply the expression of a liberty we feel, or of our own sympathy with the real or fancied manifestation of another's liberty, and is the natural echo in us of liberty." This hypothesis, with a few minor variations, is simply the theory of the odd.

We are ready to acknowledge that there is considerable truth in this view. Liberties are taken with words in a pun and with æsthetics in a grimace. Such freedoms are, however, often exhibited to us without our feeling any inclination to laugh. For an extravagance or a caprice some trait which has not yet been determined must be present.

Another considerably prevalent theory supposes the abrupt perception of a contrast between the attempt and the outcome, the appearance and the reality, the mask and the face, the tone and the words, the form and the substance, that provokes laughter. "Laughing," says Hegel in his Æsthetics, "is a sign that we are wise enough to comprehend the contrast and take note of it." According to L. Dumont, it is occasioned by the conflict in our mind of two contradictory thoughts, causing a shock. "The recognition of an object," he says, "at first gives a certain impulse to our understanding and stimulates its activity in a certain direction, when immediately a contradictory impression of another quality of the same

object comes in and forces it into a contrary direction." Still the same common theory of contrast, except that with Dumont the contrast rises to a contradiction.

Many contrasts are unquestionably ludicrous. In a parody, the comic effect is produced by the contrast of the gravity of the original work and the irreverence of the travesty. In the child's innocent expression that we laugh at, there is a contrast between the bearing of the word and the candor of the one who speaks it. Certain kinds of transpositions make us laugh for a similar reason: a tragedy rendered into a trivial style, sublime sentiments expressed in slang.

There are other contrasts in which there is nothing ludicrous. The false note of a singer is in most cases only painful; but the effect of it is a contrast. The sight of a deformed body, after looking at sound and well-proprtioned bodies, does not amuse. We do not laugh when black is set upon white. We laugh when a clown, pretending to imitate a cavalier, makes an awkward tumble, but not if a real horseman gayly trotting by meets with disaster; yet there is equally a contrast in both cases. A saying, amusing in itself, does not please when pronounced under solemn circumstances that contrast with its tenor; and nothing is so insupportable as a companion who insists on being funny when one is absorbed in admiration of something or with grief. Everything that is out of tune creates a contrast, but does not make one laugh.

Bain suggests the explanation that laughter is provoked by what he calls a degradation, meaning that we laugh when we all at once perceive something degrading, a trickery, a weakness, or a pettiness in some person or object which we respect; as when the infirmities of human nature disclose themselves in a person of importance, or when some trivial affair occurs in a solemn ceremony to drag us down, or when the wrong side of some great thing or some great man is exposed. "The occasion of the laughter is the degradation of a dignified person or interest, under circumstances that do not excite a stronger emotion. In all theories of laughter the more or less important fact is marked . . . that the feeling of the ludicrous arises when something which we respected before is presented in a mean light; for we have no disposition to laugh when something that we already regarded as such is depicted as tricky and vile."

It can not be denied that this solution agrees with many facts. We frequently, perhaps most frequently, laugh at degradation. Those words are often amusing which bring up all at once the eccentricity or the vice of some person. Degradation is even the essence of parody. We laugh at the lapse of an orator, because the man, with his weaknesses, is suddenly exposed in the midst of his sublime flight. An uncouth expression or sound uttered in an assem-

blage of grave men makes us laugh for the same reason, because humanity is detected under its mask of gravity. Monkeys make us laugh because they by their grimaces and attitudes degrade the men they imitate to their own level. In general, fatuity, pretension, and affectation are ludicrous because vulgarity is betrayed under the mask at every instant.

Yet this is not the real cause, for we often witness the spectacle of a degradation without having any disposition to laugh at it. When we perceive a pettiness in a person for whom we have reverence, we are only sorry. We do not always laugh when the eccentricity of another is exposed. Our laughing depends much on the way the exposure is made. Thus, not the odd or the exhibition of freedom or contrast or degradation is the real cause of laughter. There are queer spectacles that are not amusing, free actions that are austere, contrasts that are sad, and degradations that are solemn. The one thing that is always present, that provokes laughter, to suppress which is to suppress laughter, a variation of which has an immediate effect on the intensity of the emotion of the ludicrous, is still to be found.

Let us study a few cases; first, of what we find to amuse us in acts, and then in words. We find the application of great effort to move a load that proves to be a trifle, ludicrous; as when a man exerts all his strength to force open a door that yields at a touch, or when the clown on the stage brings all his strength to bear to lift the mock cannon ball which we know is only pasteboard. Our first impression of such actions is that they are strange or absurd. Such Herculean efforts to raise a load we know to be trifling, to overcome a resistance which we know is as nothing, are, on the first impression, incomprehensible. A second impression, however, comes on, which the psychologists seem to have missed, and which may go far to account for the ludicrous aspect of the proceeding. A rapid process of thought within us makes the act which at first seems absurd appear natural from the point of view of the actor. We think that the man supposed the door was solidly fastened, and the clown that he had a real cannon ball to lift. The effort they made was therefore natural; we should have strained ourselves too if we had been in their place, and all for nothing; and we laugh at that. What seemed queer was simply natural, an unusual fact was a habitual one, and what we thought was surprising was after all familiar. We experience a sudden revulsion of feeling, and are amused.

So in words and expressions which we regard as witty or funny. They are first presented to us in a sense and with associations which seem queer or remote; then we find that they have also a natural

and even simple interpretation. Our natural surprise at the discovery is expressed in laughter.

In the scenes which comedians present upon the stage, these double interpretations and instantaneous transitions of feeling are artfully provided for, and the success of the comedy is proportioned to the skill and plausibility with which they are worked up. When the play turns upon complicated situations and the mistakes and blunders of the character, we first perceive the absurdity of the whole as seen from our position; then instantly recognize that with the actors the matter is a serious one, and that what they are doing is correct from their point of view. The point of the joke lies in this double perception.

Some persons are slow in perceiving this point, and come in with their laughter after all the others are done. Their minds work more sluggishly, and they require more time to discover the duplex element.

Many conjurors' and circus tricks seem absurd and interest us without exciting laughter, because only the unaccustomed side of them is presented to us, and we fail to perceive wherein they have a natural side; and we are more puzzled than amused by them.

Laughter is favored by various circumstances and conditions—as a good state of physical being, infancy and youth, exultation over success, the buoyance we feel after having escaped danger, and cheerful moods. Some writers have sought the causes of laughter among these conditions; but we think they are only incidents, and simply help it by promoting freedom and agility of the mind. Children, who have no fixed habits and are vastly more susceptible to impressions than their elders, perceive the different sides of objects and their contrasts more speedily than they, and are more prone to laughter.

Mental dullness, physical trouble, disappointment, mistakes, anxiety, or mental pain are restraints upon laughter, or prevent it. Thus the more a thing appears to us at once unusual on one side and familiar on the other, the greater is the tendency to laughter; and the less pronounced the contrast the less we are amused at it.—*Translated for the Popular Science Monthly from the Revue des Deux Mondes.*

SIR ANDREW RAMSAY appears to be the first person who solved the mystery of the authorship of the Vestiges of Creation. He wrote in his diary, on the 14th of February, 1846: "At home at night reading the fifth edition of the Vestiges. Saw in it things I had told Chambers in Edinburgh after the publication of the fourth edition. He is the author."

SKETCH OF MARIA AGNESI.

By M. JACQUES BOYER.

TO assert that women have had an important influence on the progress of science would certainly be exaggeration; but to say that they have always been wholly foreign to it would be still more inexact. The female sex have, in fact, been for many centuries contributing to the extension of the field of scientific knowledge; and now that they are beginning to take a more prominent part in affairs of this category it seems a favorable time to review some of their achievements, and to notice some of the women whose scientific accomplishments have been most remarkable.

We begin with a Milanese mathematician of the eighteenth century—Maria Agnesi, a woman who was unique among the few who have occupied themselves with the exact sciences. Her precocious intelligence and a prodigious memory, which permitted her to express herself correctly in seven languages, and her rare aptitude for one of the most arduous branches of mathematics—the infinitesimal analysis of which Leibnitz and Newton had only just indicated the formulas—the saintliness of her life, divided between study, prayer, and charitable works—all contribute to make her one of the most agreeable characters which the scientific history of the last century offers us.

This illustrious learned lady was born in Milan, May 16, 1718.* Her father, Dom Pietro Agnesi Mariami, was a royal feudatory of Monteveglia, and her mother was named Anna Brivia. Baptized on the 23d of May in the basilica of Santo Nazzaro il Maggiore, she was given the name of Margaretta Gaetana Maria. She showed marked aptitude for languages from a very early age. She spoke French well when five years old, as we learn from the following sonnet by a friend of her father's: "At that age which retains only the first forms of the language of her country, and which is still easily fatigued by the task, a pretty little girl uses the French idiom with such grace and ease that a nymph on the banks of the Seine could not speak in a sweeter and more pleasant manner. It seems as if Time was afraid his flight could not keep up with the

* In the Éloge historique de Maria Gaetano Agnesi, demoiselle célèbre par ses grands talens dans les mathématiques, par se piété et sa bienfaisance, ouvrage traduit de l'Italien de Frisi (Paris, 1807, 8vo, p. 5), she is said to have been born March 16, 1718, but that is a typographical error. We should read May. This work, composed from the archives of the Agnesi family, is otherwise very exact, and a large number of the facts that follow have been derived from it. It is needless to add that the general dictionaries, including even the Biographie Universelle de Michaud (new edition, 1843, vol. i, p. 233), have rejected Frisi's error.

mind of this young person, and had appeared to slacken his march; and I, between the sight of so young an age and the charm of such an elocution, do not know which to believe—what I see or what I hear." *

It was not only in French that Agnesi made wonderful progress. She followed also the lessons in Latin which the Abbate D. Nicolo Jemelli gave to one of her brothers, and when nine years old she translated from Italian into Latin an essay which she recited before several auditors. She thus maintained—nearly two hundred years before Marya Chéliga and Maria Pognon—the right of women to study letters, the fine arts, and science if they feel called to it. This essay is dedicated to Dom Augustino Tolotta, a friend of her family and a very well educated man, to whom she modestly attributed all the merit of it. She mentions in it, among other celebrated women, Cornelia Piscopia (the oracle of seven languages), to whom the University of Padua awarded the laureate of philosophy, and Madame Dacier, translator of Homer.

Agnesi's coming out was then a brilliant one, and the rest of her life did not contradict the hopes it awakened in the minds of her friends. When eleven years of age she knew enough Greek to recite the Office of the Virgin in that language, a pious practice which she kept up till her death. Long before reaching her twentieth year, besides speaking Greek, Latin, French, and Italian, she was acquainted with German and Spanish. These many idioms, according to Mazzuchelli,† caused no confusion in her mind, and she translated freely from one language into another. She also left in manuscript a Greek translation of *Il Combattimento spirituale* of P. Lorenzo Scupoli, the two books of Supplements to Quintus Curtius of Freikshemius, translated into French, Italian, German, and Greek; three small volumes of a Greek and Latin Lexicon containing more than thirteen thousand words; and a Greek translation of a work on mythology. ‡

Miss Agnesi's health was seriously disturbed by so close application, and in December, 1730, the doctors advised her father to find some way of diverting her mind from her studies. But she, in the ardor of her application, doing everything with passion, followed

* The sonnet was dedicated, "*Alla nobile fanciulla D. Maria Gaetano Agnesi, che nell' eta cinque parla mirabilmente Francese*" (To the noble child Donna Maria Gaetano Agnesi, who, when five years old, spoke French admirably), and was written in Italian. We give it in an English unversified translation.

† Mazzuchelli. Gli Scrittori d'Italia, vol. i (1795), Part I, p. 198.

‡ The Ambrosian Library of Milan possesses, besides, numerous scientific manuscripts of Agnesi which bear witness to her prodigious industry. The principal among them are: Metáfísica e fisica, fisica e matematica, Studi di Cosmografia, Gnomonica geometrica, Fisica e matematica, Studi e correspondenze sopra varii punte del Trattato analitico.

the prescriptions too faithfully and too far, and balls and horseback riding, instead of curing her, brought on convulsions. Her disorders continued to increase immediately after the death of her mother, March 13, 1732, but she was subsequently gradually restored to quiet. This death gave rise to some changes in the family life, and Maria's father, who had five daughters and two sons by his first wife, was married a second time, February 23, 1734, to a Milanese lady, Mariana Pezzi. Two children resulted from this union, which was unfortunately brief, the second Madame Agnesi dying August 19, 1737, at the age of twenty-three years.

As a means of consolation in the grief that had fallen upon her father's household, Agnesi extended the field of her knowledge, and at last found her true career in the cultivation of philosophy and mathematics. She was not destined, it is true, to make a very prominent mark, but simply to occupy a highly honorable place among the great algebraists of the eighteenth century. Father Manera, of Cremona, and Father Michaelo Casati, professor in the Royal University at Turin, who was afterward (in 1754) nominated Bishop of Moudoir, taught her logic, metaphysics, Euclid's elements, and physics. She soon acquired great proficiency in all these sciences, and sustained theses in the presence of qualified persons. In these assemblies, after having discussed and refuted the arguments of her antagonists, she was accustomed to express her own opinions in very pure Latin. Her sister, Maria Teresa, an accomplished musician, introduced the artistic element into these meetings, which at last became so celebrated that princes and illustrious travelers passing through Milan often attended them. Many persons retained pleasant recollections of them, as is attested by the following passage from De Brosses' Letters from Italy, which is cited in M. Robière's excellent book on Women in Science, and which we quote as the story of a witness: "I would like to tell you, Mr. President, of a kind of literary phenomenon I have recently witnessed, and which has seemed to me something more stupendous than even the Duomo of Milan, and at the same time I was not taken unawares. I have just been to Signora Agnesi's, where I told you yesterday I was going. I was introduced into a large apartment, where I found thirty persons of all the European nations arranged in a circle, and Mademoiselle Agnesi seated alone with her younger sister on a sofa. She is eighteen or twenty years old, neither pretty nor plain, with a very simple and pleasant expression. First, plenty of iced water was brought in, which seemed to me a good augury. I was anticipating, when I went in, only an ordinary conversation with the lady; but instead of that, Count Belloni, with whom I was, now planned a kind of public act. He began by making the young lady a fine

address in Latin, so that every one could understand it. She regarded him attentively, and they then began to converse in the same language on the origin of fountains and the cause of the flow and ebb, like that of the sea, which some springs exhibit. She spoke like a superior intelligence on the subject; I have heard nothing upon it that gave me more satisfaction. After this conversation, Count Belloni invited me to talk with her in the same way on any subject I pleased, in philosophy or mathematics. I was astonished to find that I was expected to speak *impromptu* and in a language to which I was little used; but, be it as it might, I paid her a handsome compliment, and then we discoursed concerning the way in which mind could be affected by corporeal objects and communicate concerning them with the organs of the brain; and afterward concerning the emanation of light and the primitive colors. Toppin conversed with her on the transparency of bodies and on the properties of certain geometric curves, of which I understood nothing. Evidently Agnesi's parties are hardly of this world!"

When Agnesi was nineteen years old, she had already sustained one hundred and ninety-one philosophical theses.* Of course, they are somewhat superficial theses, in which, after having cited the principal views of various authors, Agnesi discussed and affirmed her own opinion. This proves, nevertheless, that she had received a somewhat more solid instruction than was till recently given to the young women of our time. The inquiring quality of her mind and her taste for science are likewise revealed in her correspondence. On April 26, 1733, she received from Father Manara a letter from Rome which resolved some of her doubts concerning ballistics. In another letter she sent Count Charles Belloni the solution of a problem in analytical geometry; and a response from him (July 5, 1735) cleared up some difficulties which she had met in reading the Conic Sections of the Marquis de l'Hôpital, published in 1707, of which she had undertaken to make a commentary.

Not these labors alone engaged her thoughts. Toward her twentieth year, in the very midst of her success, she contemplated retiring from the world to enter a religious society, now suppressed, called the *Celeste*, or *Turquine*, from the color of their dress, or *Carcanine*, from the name of their founder, Giovanni Pietro Carcano. But, in view of the distress that this resolution cost her father,

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* They have been published under the title Propositiones philosophicæ quas crebris disputationibus domi habitis coram clarissimis viris explicabet ex tempore et ab objectis vindicabat Maria Cajetana de Agnesis Mediolanensis (Philosophical propositions which Maria Gaetana Agnesi, of Milan, explained *ex tempore* and vindicated from objections in frequent disputations held at home in the presence of the most distinguished men), Mediolani (1738), and they are dedicated to Charles Belloni, of Paris.

she did not insist upon it, and returned to her interrupted studies. She only asked "three favors" from her father, and these were such as many women would hardly have been satisfied with: that she might dress simply, go to church when she pleased, and give up all unreligious amusements. She then devoted herself to algebra and geometry, "the only provinces of the literary world in which peace reigned," and soon her fame, passing beyond the circle of her friends, was spread through the whole learned world. Giovanni Battisto Bertucci intrusted her with his manuscript *De Telluris ac siderum vita* (September 19, 1738). She detected some inaccuracies in it, which the author corrected at once. Giacomo and Giordano Riccati read her works with great interest. Eustaccio Zanotti entertained her with his observations on eclipses. Paolo Frisi (brother to the one who composed her biography) sent her his manuscript, *De Figura et Magnitudine telluris.* Carlo Belloni intrusted his writings to her. The president of the Institute of Bologna, Beccani, submitted to her judgment the *Acta* of his academy; and finally—a well-merited distinction—Zanotti announced to her, June 20, 1748, that that learned society had just called her to be one of its members.

This election to the academy still further, if possible, stimulated Agnesi's zeal for science; and, notwithstanding the death of the last of her brothers, October 23, 1748, she published at the close of that year the great treatise on analysis which definitely established her reputation as a mathematician. Begun under the advice of Father Rampinelli, professor of anatomy and physics in the monastery of St. Victor, the *Instituzioni analitiche ad uso della gioventu italiana di dona Maria Gaetana Agnesi Milanese dell' Accademia delle scienze di Bologna*, in two quarto volumes, was received with enthusiasm, and soon took the place of the Marquis de l'Hôpital's Infinitesimal Analysis and Father Reyneau's Practical Analysis. The first volume included algebra and its applications to geometry, and the second treated of the differential and integral calculus. They were dedicated to the Empress Maria Theresa, who in recognition of the homage gave the author a box made of rock crystal and adorned with a brilliant. Pope Benedict XIV sent Agnesi a coronet of precious stones and a gold medal, which Cardinal Antonio Rufo brought to her, together with a very flattering pontifical letter, in which among other passages we read: "We undertook in the flower of our early youth the study of analysis, but afterward gave it up. We therefore only know enough of analysis to appreciate its importance and to realize how glorious it is for our Italy that it has professors of it. So far as we have been able to judge from looking over the table of contents of your work, and particularly from reading a few chapters of the analysis of finite quantities, we are in a

position to declare sincerely that you are incontestably one of the foremost professors of that subject, that your work will be very useful, that it will contribute to the literary reputation of Italy and of our Academy of Sciences at Bologna." In another quarter, two members of the Royal Academy of Sciences of Paris, de Mairan and de Montigny, were commissioned to examine the *Instituzioni analitiche*, and they observed in their report that order, lucidity, and precision reigned in all parts of the work. They regarded it, in short, as "the most complete and best composed treatise" extant on that difficult subject. De Montigny, too, in the letter accompanying the transmission of the report to Agnesi, informed her that he had desired to see her while traveling in Italy, in 1740, but circumstances had disarranged his plans, and he had been obliged to return by way of Geneva without passing through Milan. He added: "I much regretted thus missing you, but my regrets are much increased now, after having read your book; and I can never console myself for not having had the pleasure of seeing you and talking with you, for Italy has not offered me any object more worthy of my admiration. I admire especially the art with which you have brought together under uniform methods so many facts scattered through the works of the geometricians, most of which have been acquired in very various ways." The work of our learned lady had therefore a very flattering success. Other evidences of its merit are afforded by its having been translated into English by Colson in 1801, and by the translation of the second volume by d'Anthelmy into French, with notes by Bossu, under the name of *Traités élémentaires du calcul différentiel et du calcul intégral* (1775). Its remarkable character is further indicated by an observation by M. Rebière that the first works on so difficult and new a science as the infinitesimal calculus are of extreme importance.

Besides his gift to Agnesi, Pope Benedict XIV nominated her in 1750 professor of mathematics in the University of Bologna. But notwithstanding the invitation of the Roman pontiff, who reminded her that Bologna had already heard persons of her sex in its public chairs, and that he pressed her to "continue so commendable a tradition," she did not teach. Her delicate health and the education of her brothers, with which she had charged herself after the death of her father (March 19, 1752), confirmed her determination to give up her scientific work.* After that, Agnesi no longer existed as a mathematician. Maria Gaetano devoted herself exclusively to the care of the orphans and bade good-by to the world in a profession of faith in which she proclaimed, in substance, that "man ought always

* Her father had married his third wife, the noble Milanese lady, Dona Antonia Barati, and had by his three wives twenty-four children.

to work for some end—the Christian for the glory of God; my studies have had this glory in view, for they were conformed to the desire of my father. Now, finding better means of serving God, so near me, I must use them."

She began by taking two infirm persons into her rooms; and afterward she withdrew into a remote part of her house, and gave a home there to a considerable number of women, which the sale of the Empress Maria Theresa's valuable gift to a rich Englishman enabled her to increase. In 1759 she hired a house near the church of San Benedetto, at the gate called "Vigentina," in which she lived with one of her brothers after the division of the family estate was made in 1764. When this house was sold in 1771, she moved into another between the churches of Santa Maria de la Visitatione and Sant Appolinare, where, assisted by the liberality of Prince Antonio Ptolomeo Trioulzi, she took care of four hundred and fifty poor persons of both sexes. She still found means, with all these multifarious occupations, to accept invitations to dinner, for she was a foe to even the slightest eccentricity. She won the admiration of her fellow guests by the sweetness of her manners and the easy grace of her conversation. This did not cause her to neglect the reading of the Holy Scriptures, for she composed theological and ascetical writings. But after 1791, having suffered an attack of gout and her sight being weakened, she became a frequent visitor to one of the country houses of her father's estate. She died of dropsy of the breast, after a long illness, January 9, 1799, and was buried in the parochial basilica of Santo Stephano, where she is described in her epitaph as a woman remarkable for her piety, knowledge, and benevolence.*

SIR ARCHIBALD GEIKIE, in his memoir of Sir Andrew Crombie Ramsay, describing the misapprehensions to which the geologist is liable while pursuing his studies in the field, tells a story of one of the English survey staff "who, poking about to see the rocks exposed on the outskirts of a village in Cumberland, was greeted by an old woman as the 'sanitary 'spector.' He modestly disclaimed the honor, but noticing that the place was very filthy ventured to hint that such an official would find something to do there. And he thereupon began to enlarge on the evils of accumulating filth, resulting, among other things, in an unhealthy and stunted population. His auditor heard him out, and then, calmly surveying him from head to foot, remarked, 'Well, young man, all I have to tell ye is that the men o' this place are a deal bigger and stronger and handsomer nor you.' She bore no malice, for she offered him a cup of tea, but he was too cowed to face her longer."

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* The inscription on her tomb reads: Maria Gaetano Agnesi: Pietate, Doctrina, Beneficentia Insignis. H. S. E. Dec. An. MDCCXCIX, V. I. D. IAN. Aetat. LXXXI.

Correspondence.

MR. SPENCER'S TELEOLOGY.

Editor Popular Science Monthly:

SIR: In your review of the Rev. Dr. Zahm's article on Evolution and Teleology, which appeared in the April issue of the Popular Science Monthly, there are two points which are strangely at variance with the logical acumen displayed in the remainder of the review.

The first of these is the method you employ to repudiate Dr. Zahm's inclusion of Huxley and Spencer among the teleologists. You state that Huxley has been misinterpreted and that "Mr. Spencer is not a teleologist," but you give no facts to corroborate these assertions. As presented by you they are mere statements and as such can not carry weight.

But the second point is a far more serious one. When you deny that Mr. Spencer is a teleologist you overlook the fact that he has declared himself to be one. In his response to Mr. Sidgwick he discriminates between "a legitimate and an illegitimate teleology," and, after illustrating this difference, concludes his demonstrations as follows: "I am . . . arguing teleologically but in the legitimate way."

Were Dr. Zahm's conception of teleology the only possible one, your statement in regard to Mr. Spencer would undoubtedly be true. But, as the above quotation from Mr. Spencer shows, there are at least two possible conceptions. One of these, the "illegitimate," is that accepted by Dr. Zahm; while the other, the "legitimate," is doubtless that referred to by Huxley when he says, "It is necessary to remember that there is a wider teleology which . . . is actually based upon the fundamental principle of evolution."

The fallacy of Dr. Zahm's argument does not lie in his assertion that modern men of science have given evidence in favor of teleology, but in his failure to perceive the two meanings of the word.

MARGARET CHASE.

NEW YORK, *April 30, 1898.*

[In saying that Spencer and Huxley were not teleologists we expressed ourselves broadly and, in relation to the matter in hand, we think correctly. What Mr. Spencer speaks of as a legitimate teleology is not teleology at all as the word is generally understood, and has nothing whatever in common with the teleology of Dr. Zahm. "Teleology of a kind," Mr. Spencer says, "is necessarily involved in the discussion of human conduct"; and he gives a biological illustration to prove that it is possible to argue teleologically and yet in a legitimate way. This is hardly the same thing as "declaring himself a teleologist." Now what is Mr. Spencer's "legitimate teleology"? According to the example he furnishes it is legitimate teleology to say that the chief end subserved by the hardness of the shell of a particular seed is the preservation of the life of the plant producing the seed; but he is most careful to rule out absolutely the idea that the preserving of the life of the plant had anything to do with the hardening of the seed in the first place. The hardening occurred through physiological causes; and this peculiarity, happening to favor the life of the plant, became in course of time, under the action of the law of selection, an established characteristic. The teleology here may be legitimate, but it is of a very shadowy nature, and we do not think we were far wrong in ignoring it altogether.

As regards Huxley, his position is simply that it is impossible either to prove or to disprove a teleological thesis that takes in the whole universe and all recorded and unrecorded time. When he says that "there is a wider teleology which is not touched by the doctrine of evolution, but is actually based upon the fundamental proposition of evolution," he does not mean, as our correspondent, following Dr. Zahm, seems to suppose, that the fundamental proposition of evolution *supports* the teleological view, but that the upholders of the doctrine in question take their stand upon that proposition. What is the proposition as formulated by Huxley? It is that "the whole world, living and not living, is the result of mutual interaction according to definite laws of the forces possessed by the molecules of which the primitive nebulosity of the universe was composed." The new teleology, as represented by Dr. Zahm, accepts the proposition, and says that the whole machine was *designed* to work exactly as it has worked in the past, is working in the present, and will work in the future. You may tell the person who makes this assertion that he does not know anything about it, but that will not make him budge. Huxley's own position is that we do not know anything about it; and we were therefore entirely justified in saying that he was not a teleologist. He consistently held that such problems transcended human faculties.

Our treatment of Dr. Zahm's article in the Editor's Table was necessarily very brief, and we are glad our correspondent has given us this opportunity of bringing the views of two of the leading exponents of the evolution philosophy into fuller relief.—ED.]

Editor's Table.

SCIENCE AND ITS CRITICS.

IT is somewhat difficult to account for the attitude which a number of able men take toward science, an attitude of grudging recognition, of carping criticism, and too often of sarcastic misrepresentation. In England Carlyle and Ruskin have been the leading representatives of this phase of thought, if such it can be called; in France we have M. Brunetière and his school; in Russia, Tolstoi. The latter has lately republished in a Russian periodical a *brochure* by Edward Carpenter, the English title of which we at this moment forget, but the object of which is to show the abstract and unpractical nature of science; and to this he has prefixed a preface in which, following the English author, he gives science a very severe hauling over the coals.

What is it all about? What has science done to these gentlemen that they look upon it with so evil an eye? Do they dine less agreeably because science has discovered some of the laws which underlie good cookery? Are they angry with science because it has diminished disease and appreciably improved the expectation of life of each of them? Are they out of humor with it because it has done so much by anæsthetics and antiseptics to relieve human suffering? Is their grievance that a certain rational order has been introduced into our conceptions of the universe, so that, while we are still profoundly ignorant of many things, our ideas, so far as they go, have a certain harmony and coherence? If one only knew just how and where science had trodden on the corns of these very able writers, it would perhaps be possible to understand their attitude; but, as it is, in their deadly determination to find fault with science, they remind us very much of the wolf that had so heavy a bill of indictment against the lamb. The parallel stops here; the grumblings of the wolf were the necessary diplomatic prelude to the devouring of the lamb; but these gentlemen can not devour science. They grumble, and they grumble, but science goes on its way: *nulla vestigia retrorsum.*

Let us, however, examine the terms in which the great Russian author formulates his complaint:

"The strong, sensible laborer supposes that men who study, and are supported by his labor, shall be able to tell him where to find happiness. Science should teach him how to live, how to act toward friends and relatives, how to control instincts and desires that arise within him, how and what to believe. Instead of telling him these things, science talks about distances in the heavens, microbes, vibrations of ether, and X rays. The laborer is dissatisfied. He insists on knowing how to live. . . . The essential thing is the total view of life, its meaning and aims. Science can not rise to that view, religion alone can do so. . . . Science is constantly pointing to its victories over the forces of Nature, to electricity, machinery, and the like; but sensible men see not those things, they see only the misery, suffering, degradation, and hardships to which so many are subjected, and the little prospect of relief that is in sight. Were our men of science to teach men more about religious, moral, and social truths, we should not see the hundredth part of suffering and hardship which are now seen on every side."

Now, what is the answer to all this? The first answer we feel disposed to make is that the illustrious critic does not seem to have taken up as definite a standpoint as could be wished. He says at one moment that science can not rise to the point of view necessary for supplying moral guidance to the people—that religion alone can do it. A moment after he says that ninety-nine hundredths of all the suffering in the world would disappear if men of science "were to teach men more about religious, moral, and social truths." How are they to do it if science is powerless to deal with these things? Waiving this point, what may be said is this, that science reaffirms all the important moral truths that the experience of the ages has imparted to mankind, and places them on something better than an empirical basis. Mr. Spencer's two volumes on the Principles of Morality are full of valuable observations and illustrations bearing on the conduct of life; and other writers have dealt with the same general subject with various degrees of force and impressiveness. There is this distinction, however, to be drawn between moral truths and other truths, say the truths of purely physical science: the latter only require to be intellectually apprehended, the former require to be *lived*. We heard long ago of the servant who knew his master's will and did it not. Was any one but himself to blame for his disobedience? We are not told so; and Count Tolstoi has a great respect for the writings in which this type is given to us. Unhappily, the type is eternal; which of us can say with assurance that we have never fallen into like transgression?

This simple consideration, it seems to us, serves to show the folly of blaming men of science because the world is not better than it is, or for pursuing, while society is still so imperfect, their researches into distant regions of space and time, into the infinitely great or the infinitely small. Let the accusers of science say what moral truth of importance to mankind science has weakened. Let them say to what moral truth it has not at least added some strength. The Founder of Christianity did not rail at science. He did not say that it was because the Scribes and Pharisees did not teach sound and penetrating moral doctrines that the world was as bad as it was. As reflected in the fourth Gospel, what he taught was that there was a light which was ready to lighten every man that came into the world, but that "men loved darkness rather than light because their deeds were evil." To day there are thousands of agencies in operation for instructing men in their duties and teaching them the significance of life, and there is reason to hope that they are not all working in vain. Only we must bear in mind that all moral teaching is a summons to moral effort, a summons to rise above our everyday selves, a summons to more or less of self-renunciation. Why should men of science be blamed because they are not infinitely more successful than ministers of the gospel in enlightening dark minds and strengthening weak wills? If it is the function of religion, as Count Tolstoi says, to take the total view of life and seize its true significance, why does it not fulfill that duty? It really is most singular that no sooner has the eminent critic got to the point of seeing where the responsibility lies for the proper instruction of mankind, than he turns savagely round on the men of science, and tells them that if *they* would deal out religious, moral, and social truths to mankind, the miseries and hardships of our present social state would all but disappear.

Mankind, let us trust, is slowly

climbing the ascent to a higher moral state and better social relations; but what all reasonable persons should recognize is that it is not merely knowledge that is needed to sway men in the direction of right action. Whether knowledge is effectual in prompting to any action depends upon the manner and circumstances in which it is applied. Men sometimes gain wisdom from experience, and sometimes their moral natures respond to the appeals of some great teacher; but it is probable that the most solid gains which humanity makes result from the action of selection—the kind of selection which social life sets in operation. To say that science puts forward claims which it can not make good is a misrepresentation, as we have often shown in these columns. Science gathers knowledge and makes this knowledge available for all the world. If it is not more actively engaged in missionary work we fail to see matter for surprise. There are, as there have always been, diversities of gifts in the world, and it is not only possible but probable that the skilled observer, or the acute inductive reasoner, might not have any great talent for evangelizing the masses. Still, in a world where knowledge and theory are both so much required, such laborers are surely worthy of their hire. Why they should be singled out for the taunts and reproaches of eminent men of letters it is difficult to see. It would come with better grace from these gentlemen if they would direct their strictures first to those of their own craft, and ask the critics, essayists, and novelists of to-day why they do not take in hand the regeneration of society instead of spending their energies, as so many of them do, in the search for mere literary adornment or in striving to say cleverly things that might better never be said at all. But the great truth which should never be lost sight of is that moral progress is for every individual a personal question and is a matter of personal endeavor. Whether virtue can be taught is a question as old as Plato and probably much older. However that question may be decided, one thing is certain, that growth in virtue can not come from teaching alone, and that to blame men of science for not converting the world by means of lectures on moral philosophy is idle in the extreme.

SCIENTIFIC INSTRUCTION IN GIRLS' SCHOOLS.

THE article on this subject by Mrs. Caroline W. Latimer which we published in our last number is one deserving of careful attention. A careless reader might possibly dismiss it as a plea for less science and more literature in girls' schools; but we do not ourselves so understand the writer. The contention is that in many, if not in most, schools scientific instruction is not judiciously imparted; that too many different sciences are driven abreast, as it were; and that, in seeking to cover too wide a field of knowledge and embrace too great a multiplicity of facts, the best results of scientific study are lost. We hold it entirely possible that such is the case, and when our contributor says that she knows from experience that it is so, it is reasonable to allow considerable weight to the statement. At the same time the very overloading of school curriculums with scientific studies—admitting all that our contributor says on the subject—must be regarded as an encouraging sign, for it shows that science has fairly conquered a domain from which only a generation ago it was almost wholly excluded. If it has overrun the territory in too promiscuous a manner,

that can easily be remedied; and, by the aid of a little reflection and experience, scientific instruction in girls' schools can be so organized as to produce the best results as regards not only the direct imparting of scientific knowledge, but also the infusing of new life and significance into other branches of study.

We quite agree with our contributor when she says that scientific teaching unaccompanied by practical work on the part of the student is a very ineffectual, not to say wholly useless, thing. Mere oral instruction or the study of text-books will never impart any adequate sense of the need for evidence or of the nature of verification; far from weakening, it can only tend to strengthen the habit of dependence on authority. But set young minds to make their own observations and draw their own conclusions, to verify experimentally the theories contained in the text-books, instead of simply taking them on trust, and the intellectual benefit will be lasting and far-reaching. Lessons of patience and exactness will be taught that can not fail to be of value in after life; and the highest purely intellectual result of education will be achieved in the acquisition of a true conception of the manner in which knowledge is built up and rational certitude acquired in all matters accessible to the human mind. The difference is vast between a mind which knows what verification is, what an experiment is, and one that wholly lacks such knowledge. The one can take a more or less accurate measure of the facts of life and of any given situation, while the other is to a great extent at the mercy of haphazard impressions. The one sails a definite course, making the best use of every wind; the other is apt to change its course with every change of wind.

In girls' schools the study of science assumes a specially important function. The fashionable doctrine to-day in some quarters is that there is no sex in mind; but, for our own part, we incline to think that even in these latter times there is sufficient difference in the mental habits of men and women to render instruction in the facts and methods of science of more pressing need from the point of view of individual development in the case of the latter than in the case of the former. Writers who are not open to the suspicion of prejudice dwell on the greater "instinctiveness" of women as compared with men. Instinctiveness may be a valuable quality, but it has the drawback of dictating a very summary and personal manner of deciding questions which really depend wholly on external evidence. It is common enough among men for the wish to be father to the thought; but in the case of women we may use with considerable appropriateness the ponderous paraphrase of Dr. Johnson, and say that "desire superinduces conviction." Not merely a thought, be it remarked, but *conviction;* and how convinced a woman may be on the side of her desires perhaps most people have experienced.

Some one may say that this is an interesting condition of mind, a kind of sweet unreasonableness, which no one should seek to interfere with. Banter of this kind may at times be amusing, but it does not decide any serious question. The study of science affords precisely the intellectual exercise best adapted to check waywardness of thought and bring the mind into a right relation to the questions which have to be faced in everyday life. It shows one clear road, one well-established highway, to true conclusions, and reveals the danger of short cuts and hasty

judgments. It accustoms the mind to ask, in regard to any proposition or statement, "What is the evidence for this?" It accustoms the mind also to a condition of suspense in regard to questions which there are not sufficient data for deciding. This condition of suspense is precisely what untrained minds find it most difficult to endure. We have lately had experience of this on an immense scale in this country. When the explosion occurred by which the Maine was destroyed, how few were willing to await the result of expert investigation before arriving at a conclusion consonant with their own feelings on the subject! It is not uncommon to find people who show irritation if you express a doubt whether some statement they have read in the papers, and happen to be interested in, is well-founded. Belief is of the nature of an emotion, the indulgence of which is to the mass of mankind a pleasure. The student of science early learns that the emotion is one which requires control, and gradually he or she forms the habit of making reasonable verification a necessary condition of belief.

Another great advantage that science possesses, especially in relation to the female sex, lies in its impersonal character. In other spheres of activity personal leadership counts for much; but in the study of science, while individual teachers may exert a powerful stimulating influence, they do not impose their opinions. In all scientific work the one "ever-fixed mark" is truth, the proved conformity of fact with hypothesis. How interesting soever the views of this or that eminent professor may be, they must at all times submit to this test; and the humblest student may at any moment shatter by an experiment or an observation the most brilliant generalization of the most renowned speculator. We do not know of any lesson that can be more usefully taught in girls' schools than this—that truth is above all, and that truth depends, not upon any form of personal authority, but upon the direct revelations of Nature to those who interrogate her aright. This does not involve any depreciation of personal influence, which must always remain a powerful factor in the government of human life; it simply gives the mind a wider outlook upon the world, enabling it to pierce beyond opinion to something greater and more enduring than opinion, the ever-unfolding reality of things.

> "Our little systems have their day,
> They have their day and cease to be."

This utterance of a great poet is at one with the teachings of science; but what it is well to remember is that, as system after system fails, truth shines forth with ever clearer radiance and more benignant grace: it does not sink in their fall, but escapes to assume better forms and confer still higher blessings on human kind.

We are in sympathy with what our contributor says as to the desirability of supplementing the careful teaching of one or two sciences with general views, intelligently imparted, of all other leading branches of science. She recommends for special study in girls' schools physiology as a necessary subject, and either botany or zoölogy. We should like to put in a word for astronomy on account of the strong appeal it makes to the imagination, and the opportunity it affords for bringing into use whatever the pupils may have learned in the way of mathematics. Another reason may be found in its extremely interesting history. No young person should leave a school claiming to give a solid education without having learned something of the

labors of the old world astronomers, as well as of Copernicus, Galileo, Kepler, Newton, and Herschel. One of the keenest of intellectual and emotional, we might perhaps say moral, pleasures is lost to him or her who, in the

"Rolling heaven, with all his signs revealed,"

sees nothing but a medley of scintillating points, some brighter and some less bright, and knows far less of the movements of the heavenly bodies than the old Chaldean shepherds. The study of astronomy, we have reason to believe, is generally taken up by girls with much interest when an opportunity of doing so is afforded them; and we should like to ask Mrs. Latimer to try if she can not, in addition to the well-chosen sciences she mentions, find room for some really educative work in astronomy. With this addition her scheme would have our hearty approval.

Scientific Literature.

SPECIAL BOOKS.

MR. *Evans's Evolutional Ethics and Animal Psychology** deals in the first place with the origin and early growth of ethical conceptions, but more especially as the treatise goes on, with the physical and mental relations of animals and men, and the rights of animals as flowing out of these. "The intimate connection between evolutional ethics and animal psychology," the author says, "must be apparent to all who carefully consider the influence necessarily exerted by a proper appreciation of animal intelligence upon the recognition of man's moral relations and obligations to the creatures with whom he is so closely associated, and who are so largely subject to his dominion"; and "the measure of our duty toward lower organisms is determined by the degree of their mental development. . . . The only foundation of animal ethics is animal psychology." The discussion is opened with a View of the Ethics of Tribal Society, or that stage of the development near the beginning when rights were not recognized outside of the narrow circle of the tribe, and all others than those of the tribe were regarded as enemies. The idea was gradually expanded through the symbolism of the brotherhood of blood, the sacred rite, as we might call it, of hospitality, and the supposititious or ceremonial recognition of the kinship of tribal chiefs. Then the bond of community of religious belief came in to be a basis of moral obligation. Psychology and ethics were still, however, anthropocentric, and man was considered as essentially different and inseparably set apart from all other sentient creatures, a superior being, bound to them by no ties of mental affinity or moral obligation. The doctrine of metempsychosis, under which the soul was supposed in the next stage of existence to become incarnated in another man or a beast, came in to modify this view, and to prepare a way for the recognition of animal rights. Men came to observe the intelligence of beasts, and to find in them evidences of the possession of something more or less remotely resembling the mental faculties of man.

* Evolutional Ethics and Animal Psychology. By E. P. Evans. New York: D. Appleton and Company. Pp. 366. Price, $1.75.

The growth of this view is traced in its various aspects, the results deducible from them are set forth, and we are brought to the present state of the discussion, in the chapter on Mind in Man and Brute and those which follow it. "Modern scientific research has not only discovered a multitude of physical correspondences—analogical and homological—between man and brute, but it has also detected and brought to light many irrefragable proofs of their psychical kinship. The more exact and extended our knowledge of animal intelligence becomes, the more remarkable does its resemblance to human intelligence appear." The capacity of animals to adapt themselves to new conditions is discussed, and incidents are adduced in which it has been shown, in a chapter on Progress and Perfectibility in them; their power to form concepts, plan, and pursue a systematic course are considered under the head of Ideation in Animals and Man, and cases of the organization of communities, trial by courts, the use of tools, etc., by them are cited. The existence of such a barrier as the possession of the power of speech by man and the destitution of it by animals is questioned. Finally, evidences are adduced of the presence of an æsthetic sense and the foreshadowing of a religious sentiment in animals. "It is through the portal of spiritual kinship, created by modern evolutional science, that beasts and birds, 'our elder brothers,' as Herder calls them, enter into the temple of justice and enjoy the privilege of sanctuary against the wanton or unwitting cruelty hitherto authorized by the assumptions and usurpations of man."

In *Aristocracy and Evolution* * Mr. *W. H. Mallock* first inquires what determines the production and ascendency of superior men, what their office in the world is, and what they effect; and then applies his conclusions to current social questions, particularly to that of the distribution of wealth. By *aristocracy* he means in this book no artificial or conventional class, but "the exceptionally gifted and efficient minority, no matter what the position in which its members may have been born, or what the sphere of social progress in which their exceptional efficiency shows itself." He prefers the word to *oligarchy*, "because it means not only the rule of the few, but of the best or most efficient of the few." He regards it as a fundamental error in modern sociological study that it attributes all progress to *man*, while, according to his own doctrine here set forth and expounded, progress is the work of only a few men who have led the others; that it regards great men as products or at most incidents of human and social evolution, while he would regard them as pioneers and chief factors of it. No hard-and-fast definition is predicated for greatness, but it is regarded as various in kind and degree. "Great men are not necessarily heroes, as Carlyle thought, nor divided absolutely from all other men," but there is a certain minority of men who resemble each other in being more efficient than the majority, as we may see in literature and art, in the scholarship of boys at the same school, and similarly in practical life. A man may be ordinary in one respect and great in another, but the majority are not great in any. The great-man theory asserts that if some men were not more efficient than most men no progress would take place at all. Such men promote progress not so much by what they do themselves as

* Aristocracy and Evolution: A Study of the Rights, the Origin, and the Social Functions of the Wealthier Classes. By W. H. Mallock. New York: The Macmillan Company, pp. 383. Price, $5.

by what they help others to do. Greatness, however, is not in all cases equally beneficial, but the influence of some great men is more advantageous than that of others. Progress, therefore, involves a struggle through which the fittest great men shall secure influence over others and destroy the influence of the less fit. The discussion turns to the office of the great man in wealth production and his power in politics, to the parts contributed to a joint product by the few and the many, to the dependence of exceptional action on the attainability of exceptional reward, and to the motives of the exceptional wealth-producer. Under the last head the justification of income from capital is shown to rest on the fact that the power of capital to yield income is what mainly makes men anxious to produce it, and that it must be transmissible and heritable, else those social results would not be produced which make it valuable. While the majority may and do acquire a share of the increment produced by the great man, it can never be such as to make social conditions equal, for opportunities can not be made equal. Educational help may do much indeed to increase the supply of exceptional though not great talent, but when applied to those whose exceptional gifts are ill balanced or whose intellects are not sound, it results in mischief, stimulating talents that will be ill applied and developing tastes that can not be satisfied, breeding agitators and causing discontent. "The average man should be taught to aim at embellishing his position, not at escaping from it." The unequal distribution of wealth has no natural tendency to cause unhappiness, for men's desires vary. Equality of desires exists only for the necessaries of life, for this desire rests on men's physical natures, which are similar, while the desire for superfluities depends on their mental powers, which vary, and the special appeal of luxury is mainly to the mind and the imagination. The desire for wealth is speculative, and implies no pain caused by the want of it, and is, in fact, in proportion to each man's belief that wealth is attainable by him. Finally, the socialistic teaching of to-day creates a spurious desire for wealth by its doctrines of impossible rights to it, and its theories merely cause a barren and artificial discontent that interferes with that harmonious progress on which the welfare of the many depends. They make enemies of classes who would otherwise be allies, to the incalculable injury of the cause of true social reform. Mr. Mallock's purpose in this work is to show the fallacy of these theories, and to demonstrate the dependence of the many upon the co-operation of the few.

GENERAL NOTICES.

We have already, in our sketch of James Croll (Popular Science Monthly, August, 1897), given a picture, however inadequate, of the heroic struggles of that student who, to use the words of Lord Kelvin, "presented in his life a rare case of inborn passion for philosophy and science conquering all obstacles and attaining to the object of lifelong devotion in scientific research and philosophic speculation"; and can hardly have failed to convey some idea of the incidents which his life developed, and which are set forth more in detail and consecutively in the autobiographical sketch and memoir of his life and work prepared by his friend *James Campbell Irons*,* to which we were most largely indebted for the material for our sketch. It is only necessary here to call attention to this book for the information of all persons who would like to know more of Dr. Croll's life and work, as well as of those

* Autobiographical Sketch of James Croll, LL. D., F. R. S., etc. By James Campbell Irons. London: Edward Stanford. Pp. 553.

who would exalt the noble qualities displayed by the hero of the story, and laud his successful achievement. The autobiographical sketch, which was never completed, occupies thirty-two pages of the volume, and is given as Dr. Croll left it, upon the advice of Professor Masson, that "it is so characteristic that it would be best to preserve it entire, as it would be a pity to lose anything of the simple and pleasant peculiarities of the autobiographical original." To this has been added the more detailed account of Croll's life and scientific work, making up the rest of the book. Mr. Irons has been assisted in his work by many of the distinguished scientific men of Great Britain, who have furnished Dr. Croll's correspondence with them, criticisms, suggestions, etc. To the biography are added obituary notices by Lord Kelvin, Nature, and J. Horne, of the Geological Survey of Scotland; a letter from Prof. R. W. McFarland, formerly of Ohio State University, on Croll's relations with America and its geologists; and a list of Dr. Croll's publications.

In Mr. *Ramsey's Philosophy of Phenomena* * all phenomena are classified as physical and metaphysical (matter phenomena and life phenomena). The cosmic forces of gravity, heat, and life are recognized as chief factors of all phenomena. The author's method is to present his views—which are usually very peremptory—in maxims or detached sentences; and we have not been able to perceive that the book as a whole leads up to anything in particular. His observations cover most of the branches of knowledge, and embrace general statements of reviews or opinions on the several points, with his own verdicts. He seems to apprehend that he will arouse animosity; but the world is more likely to respect the independent thinker who is not afraid to utter his views in plain language, and will simply take the liberty of differing from him where it does not agree.

M. *Félix Le Dantec*, whose publisher styles him "a young zoölogist of great promise for the future," confesses to having no new facts to present in his book on *Individual Evolution and Heredity.** The important feature of his present study is to him the method, which he believes is different from that employed by any other author who has written upon the subject. His object is to account for the inheritance of acquired characteristics, and this he endeavors to do by purely deductive methods. He believes that the sole difference between living bodies or plastids and crude substances lies in the presence or absence of the property of assimilation. This property, then, should be the basis of all biological study, and all that is general in biology should be deducible from it. Heredity is therefore a form and the work of assimilation—assimilation of the traits of ancestors transmitted to posterity and perpetuated through them.

"One approaches Hegel for the first time," says the author of *The Secret of Hegel*,† "as one might approach some enchanted palace of Arabian story. New powers, imagination is assured (were but the entrance gained), await one there—secrets—as it were the ring of Solomon and the passkeys of the universe. But very truly, if thus magical is the promise, no less magical is the difficulty; and one wanders round the book—as Aboulfaouris round the palace—*irrito*, without success, but not without a sufficiency of vexation. Book—palace—is absolutely inaccessible, for the *known* can show no bridge to it; or, if accessible, then it is absolutely impregnable, for it begins *not*, it enters not. What seems the doorway receives but to reject, and every attempt at a window is baffled by a fall. This is the universal experience." We are not disposed to question the appositeness of the figure as illustrating Hegel's style of thought. What now is the student to do when he finds the expositor whom he hopes to use as the passkey to this strange palace falling into the same way of inaccessibility and impenetrability as his master? Dr. Stirling's chapters on Hegel consist for the most part of certain members of a series of notes "which, as it

* Philosophy of Phenomena. By George M. Ramsey. Boston: Banner of Light Publishing Company. Pp. 208.

* Evolution individuelle et hérédité; Théorie de la Variation qualitative. By F. Le Dantec. Paris: Félix Alcan

† The Secret of Hegel. Being the Hegelian System in Origin, Principle, Form, and Matter. By James Hutchison Stirling. New York: G. P. Putnam's Sons. Pp. 751.

were, fell by the way during the writer's own *struggle* to the *Logik* and the *Encyclopaedie*." The thought of publishing them was not entertained at the time, but, while some of them were destroyed before any such thought occurred, what remain are given unchanged; and the hope is entertained that "they may assist, or, should they fail to assist, they may succeed to encourage; for, representing various stages of success or unsuccess in the study of Hegel, they may be allowably expected to have peculiar meaning for more than one student, who, finding his own difficulties reflected in what claims to have passed them, may feel himself stimulated afresh to a renewed attempt."

A new feature presents itself at first sight in the volume on metals of Mr. *Bailey's Tutorial Chemistry*.* Chemical physics is given prominence, and the first place. Yet the author has sought to include only such topics as are essential to a due appreciation of the modern science. The section, however, contains many subjects that are not commonly brought before the student at so early a stage. The elements are taken in the order suggested by the periodic system, and the characteristic properties of each family are summarized. This has been done, the author says, so as to bring out the relationships which exist between the different members of the same family, and so as to represent (by a consideration of these summaries progressively) the whole of the chemical elements in a continuous series. A list of experiments is given in the appendix. The literary style of the book is concise and clear.

Professor *Ladd* has written his *Outlines of Descriptive Psychology*† with the definite intention constantly in view of adapting it to certain beginners—students in colleges and normal schools—with an average grade of culture and the average amount of time at disposal. He has therefore had in mind throughout both the pupil and the teacher in their mutual relations, and has taken all pains so to present the subject that it can be "intelligently and 'economically' yet thoroughly studied and successfully taught." The subject, the phenomena of human mental life, is treated from the different points of view, and with the aid of all the methods of research, particularly those of experimental and physiological investigations, which belong to modern psychology. These investigations are, however, at least for the present, liable to the criticism that they are unable to deal with the later and more complex developments of the mind. "Unless we describe, and as far as possible explain, the growth of intellect, the knowledge of self and of things, the formation of the higher sentiments and emotions, and the conditions for the attainment of character, we neglect the main part of the task of the psychologist." Without overlooking the treatment of more fundamental processes, the author has tried to give these "higher faculties" the amount of space they deserve and require. Admitting that the value and success of the experimental method ought not to be questioned, Professor Ladd believes that its representatives are tempted to exaggerate its promise and its superior productiveness, and maintains that it can never be pursued without dependence upon introspection. Both the analytic and the genetic methods of treating the subject are followed. In the first part of the work, The Processes of Mental Life, those elementary forms of functioning which analysis discovers as entering into all mental life are described. In the second part, The Development of Mental Life, the evolution of the principal faculties of mind is traced as much as possible in their combined and interdependent action. Clearness, conciseness, and order are sought in the presentation.

Mr. *Edward Bradford Titchener* aims in his *Primer of Psychology** to outline, with as little of technical detail as is compatible with accuracy of statement, the methods and results of modern psychology, and to stimulate the reader by means of questions and

* The University Tutorial Series. The Tutorial Chemistry. Part II, Metals. By G. H. Bailey. Edited by William Briggs. London: W. B. Clive, University Correspondence Press. New York: Hinds & Noble, Cooper Institute. Pp. 300.

† Outlines of Descriptive Psychology. A Textbook of Mental Science for Colleges and Normal Schools. By George Trumbull Ladd. New York: Charles Scribner's Sons. Pp. 428. Price, $1.50.

* A Primer of Psychology. By Edward Bradford Titchener. New York: The Macmillan Company. Pp. 314. Price, $1.

exercises and of references to more advanced treatises to further study of the subject. The primer stands in close relation to the author's previously published Outline of Psychology, but, being intended as a first book, its exposition is simpler, while its range is wider. Greater emphasis is laid throughout upon the fact of mental evolution. The definition of psychology and its work are discussed in the first chapter and its method in the second; and after these follow the several chapters on the conditions, operations, and powers of the mind, advancing from the simpler, sensation, etc., to the more complex, memory and imagination, thought and self-consciousness, sentiment, etc. The treatise ends with the discussion of abnormal psychology and an exposition of the province and relations of the science. The whole discussion goes, as the author believes, to show that psychology, so far as it has gone, makes up an orderly and systematic body of knowledge.

To the Concise Knowledge Library Maps D. Appleton and Company have added *Astronomy*, by *Agnes M. Clerke* and two other well-known students and writers on the subject.* The aim of the work is to present in concise form a popular synopsis of astronomical knowledge to date. For this purpose authors are employed who are thoroughly conversant with the science and its literature, with the present theories and with current observations and their results, and who have earned a reputation for ability to present these things in a style intelligible and interesting to the general reader; and the reports of the most recent work in astronomy in the United States and abroad have been consulted. The work of authorship is systematically divided among the three writers whose names stand as sponsors for the book. Miss Clerke gives a brief historical sketch of the science from Hipparchus to the present time and furnishes the account of the solar system. Mr. Fowler, demonstrator of astronomical physics to the Royal College of Science, briefly outlines the general principles of spherical and gravitational astronomy, and describes the instrumental means now at the command of observers in the various branches of astronomical research; and Mr. Gore treats of the sidereal heavens. The work is illustrated by a large number of diagrams, and other designs prepared expressly for it, and by a number of reproductions of photographs and drawings made by distinguished astronomers in Europe and America. Among the observers and others to whom acknowledgments are made we find the names of American astronomers frequent and conspicuous.

A great deal of useful information and as much good taste are embodied in Mr. *Bailey's* little book on *Garden Making*,* and it is further full of suggestions for readers who may be able and disposed to plan and carry out gardening enterprises beyond the limits of the immediate teachings of the book. It deals with the kitchen garden and the ornamental grounds, their laying out, the tools to be used upon them and the best methods of operating, what to put into them, and all matters pertaining to their care and cultivation. The first section is General Advice, the second on the Plan of the Place. Then follow hints and instructions on Planting the Ornamental Grounds, the Fruit Plantation, the Vegetable Garden, lists of trees, shrubs, flowers, fruits, and vegetables, and calendars of operations for the North and the South. The author has been aided by L. R. Taft, F. A. Waugh, and Ernest Walker, professors of horticulture in Michigan, Vermont, and South Carolina.

A manual of *Laboratory Experiments on the Class Reactions and Identification of Organic Substances*, prepared by Prof. *Arthur A. Noyes* and Prof. *Samuel P. Mulliken* and published by the Chemical Publishing Company, Easton, Pa. (50 cents), describes experiments upon the class reactions of organic compounds; experiments illustrating the methods of detection of nitrogen, sulphur, and halogens in organic compounds; and methods of identification and separation of unknown organic substances. While the primary purpose of the experiments described is to illustrate the characteristic reactions of organic compounds, the importance of

* The Concise Knowledge Library. Astronomy. By Agnes M. Clerke, A. Fowler, and J. Ellard Gore. New York: D. Appleton and Company. Pp. 581, with plates. Price, $2.

* Garden Making; Suggestions for the Utilization of Home Grounds. By L. H. Bailey. New York: The Macmillan Company. Pp. 417. Price, $1.

their analytical features is insisted upon, and that side has been made prominent; and an important part of the course consists in the identification of unknown compounds and the quantitative separation of mixtures by methods devised by the student himself with the help of the knowledge gained from the experiments with known substances.

In his book on the *Freezing Point, Boiling Point, and Conductivity Methods* of chemical laboratory work (Easton, Pa.: Chemical Publishing Company, 75 cents), Prof. *Harry C. Jones* aims chiefly to give an account of the operations involved in carrying out these methods in the laboratory. But, observing that they are rarely treated in a single work from the points of view of both theory and practice, and regarding the mere mechanical application of any scientific method as a matter of comparatively little significance, he has sought also to give enough of the theoretical ground on which each of them rests to enable the student to work with them intelligently, and to see clearly their scientific significance and use.

Another addition to D. Appleton and Company's series of Home-Reading Books is *The Animal World, its Romances and Realities*, a reading book of zoölogy, prepared by *Frank Vincent* on a similar plan with his book on The Plant World, which has found much favor. As in the other book, the subject has been approached from as many conspicuous and characteristic points as possible. The selections are made with a view to the entertainment they may give as well as to the instruction, and to their fitness to awaken the curiosity of readers and stimulate them to independent observation and investigation. Poetical extracts are admitted, Wordsworth, Emerson, Ferdinand Freiligrath, Shelley, Procter, Matthew Arnold, Holmes, Charles Lamb, and William Blake being represented among them. Something is given about every grand division of the animal kingdom; and articles are inserted on The Task of Classification and The Distribution of Animals.

The Forester, a valuable journal advocating the preservation and care of forests, arboriculture, and the economical management of timber, formerly published and edited by Mr. John Gifford at Princeton, N. J., has passed under the control of the American Forestry Association, which, enlarging and improving it, will make it its organ. It is intended to give prominent attention in each number to some one phase; as the White Pine Situation in the January number of 1898, the National Forest Reserves in the February, the Spruce Supply in the March, and Tree-planting in the April numbers.

Prof. *David P. Todd* insists, in his *New Astronomy for Beginners*, on the value and adaptability of astronomy as a laboratory study. It is pre-eminently a science of observation, and there is no sufficient reason why it should not be so pursued. "Although the pupil's equipment be but a yard-stick, a pinhole, and the rule of three, will he not reap greater benefit from measuring the sun himself than from learning mere detail of methods employed by astronomers?" The science is presented, not as a mere sequence of isolated and imperfectly connected facts, but as an interrelated series of philosophical principles; rudimental principles of navigation in which astronomy is concerned are explained; observatories and their instruments are described; the law of universal gravitation is more fully expounded than is usual in elementary books; various questions receive special attention; while mathematical results are given, the beauty and interest of the study are not obscured by unnecessary mathematical processes; and the importance of the student's thinking rather than memorizing has been everywhere kept in mind. The book is commendable in its matter and manner. (Published by the American Book Company. Price, $1.30.)

The principal subject mentioned in the *Records of the American Society of Naturalists* for December, 1896, is the report of the committee on the practicability and the ways and means of further prosecuting antarctic research. The committee had given the matter some time and consideration, but was not yet in a position to state definitely the possibilities of the undertaking in question.

Under the title of *Parasitic Wealth, or Money Reform* (Chicago, Charles H. Kerr & Co., $1), *John Brown* issues "a manifesto to the people of the United States and to the workers of the whole world," calling attention to financial and social reforms which he

thinks are needed and proposes. He thinks it a monstrous wrong that so few men should hold so vast a proportion of the property and domain of the country as is in the possession of the corporations and the relatively small group of wealthiest men; that the system of interest is wrong; that the monetization of gold is a mistake and contributes to the growth of parasitism; and that the protective system is unjustly oppressive. His plan of reform includes nationalization of land, railroads, waterways, and telegraphs by purchase, the certificates issued in payment for these franchises to constitute our money; the value of the money to be regulated by a land-tax rate, and its volume to be maintained on a uniform *per capita* basis and to be of such amplitude as to avoid premiums; the demonetization of money metals and the redemption of all coin money and paper obligations in the new lawful money; the nationalization of banks and the establishment of a bank service charge in lieu of interest; the repeal of all tariff, excise, and internal revenues, to be replaced by the land tax; maintenance of a public improvement fund; the removal of all public service out of the reach of partisan influence or interference; and selective immigration.

From a study of *The True Route of Coronado's March* (1540) through New Mexico and the intervening districts to the Arkansas River, in the light of the writings of the period, F. S. Dellenbach has come to conclusions entirely at variance with those of all previous investigators. His paper is very interesting for this reason and in itself.

PUBLICATIONS RECEIVED.

Agricultural Experiment Stations. Bulletins and Reports. Connecticut: Report for 1897. Part IV. Pp. 100; Bulletin 126. Insecticides. Pp. 12; No. 127. Cost of Plant Food. Pp. 10.—Cornell University: No. 146. Fourth Report of Progress on Extension Work. Pp. 28.—Michigan: Thirty-fifth Annual Report of the Secretary of the State Board of Agriculture and Ninth of the Experiment Station. Pp. 540.—New Hampshire College: Press No. 36. Fertilizers. Pp. 1; No. 50. Dehorning Cattle. By F. W. Rane and H. H. Lamson. Pp. 12; Sweet Corn. By F. W. Rane. Pp. 24.—New York: Nos. 127, 128. Popular Edition. Small Fruits in 1897; No. 136. Inspection of Nurseries, etc. Pp. 30, with plates; ditto. Popular Edition. Pp. 10, with plates; Popular Editions. No. 137. Potato Fertilizing. Pp. 5; No. 138. Diseases of Plants. Pp. 6; No. 139. Combating Plant Lice. Pp. 5, with plates; No. 140. Wood Ashes and Apple Scab. Pp. 6; No. 141. Stock Feeding. Pp. 6; No. 142. Director's Report for 1897. Pp. 12.—North Dakota: No. 32. Chemical Studies. Pp. 12.—Ohio: No. 31. Lung and Stomach Worms of Sheep. Pp. 16.—United States Division of Forestry: Progress in Timber Physics. Pp. 20.—West Virginia: No. 50. The Periodical Cicada. By A. D. Hopkins. Pp. 48; No. 51. Commercial Fertilizers. By H. H. Hite. Pp. 36, with chart; Spray Calendar. By L. C. Corbet. Chart.

American Agriculturist Yearbook and Almanac for 1898. New York: Orange Judd Company. Pp. 665. 50 cents.

Beker, Gustabo Adolfo. Rrimas. Valparaiso, Chile: Karlos Kabezon. Pp. 181.

Bickerton, A. W. A New Story of the Stars. Christ Church, New Zealand. Pp. 150.

Bulletins and Reports. Michigan: Monthly Bulletin of Vital Statistics. April, 1898. Pp. 20.—National Association of Wool Manufacturers: Quarterly. June, 1898. Pp. 100. 50 cents.—New York State Library: Director's Report, 1897. Pp. 69. 10 cents.—New York Zoological Society: Second Annual Report. Pp. 143, with plates.—O'Sullivan, Henry: Report of Progress of Exploration in the Counties between Lake St. John and James Bay, Quebec.—Philadelphia: Annual Report of the Superintendent of Public Schools for 1897. Pp. 119.—Schimmel & Co.: Semiannual Report (essential oils, etc.). Leipzig and New York. Pp. 59.—United States Department of Labor: Bulletin No. 16. May, 1898. Alaskan Gold Fields. Washington. Pp. 212.—United States House of Representatives: Report on National Exposition in 1899. Pp. 19.

Chautauquan, The Texas-Colorado. Monthly. April, 1898. Boulder and Fort Worth. Pp. 16. 5 cents.

Dana, James D. Revised Text-Book of Geology. Fifth edition, revised and enlarged. Edited by William North Rice. American Book Company. Pp. 482.

Foss, Dr. Das Freiherrlich von Sierstorpff-Cramm'sche Bad Driburg in seinen alten und neuesten Heilfactoren, etc. (Pamphlet about the Driburg bath, Germany, and hygienic bathing in general.) Brunswick: F. Vieweg & Son. Pp. 33.

Garnett, Richard. A History of Italian Literature. New York: D. Appleton and Company. Pp. 431. $1.50.

Illinois Steel Company, Chicago. Mineral Wool for Insulation of Cold Storage and Use in Architecture. Pp. 16.

La Barra, Eduardo de. Literatura Arcaica. Valparaiso, Chile: K. Newman. Pp. 373.

McConachie, Lauros G. Congressional Committees. New York: T. Y. Crowell & Co. Pp. 441.

Mercer, Henry C. Light and Fire Making. Philadelphia: MacCalla & Co. Pp. 29. 50 cents.

Minero, El, Mexicano (The Mexican Miner). Weekly. Mexico. Pp. 16.

Parkhurst, H. E. How to Name the Birds. New York: Charles Scribner's Sons. Pp. 115. $1.

Proceedings, Transactions, etc. Kansas Academy of Sciences: Transactions, 1895-'96. Pp. 226.—Medico-Legal Society of New York: The Truth about Cigarettes. Pp. 48.—Society for the Promotion of Agricultural Science: Eighteenth Annual Meeting. Pp. 85.

Pyburn, George. Labor the Creator of Capital (Quarterly Studies in Socialism, No. 2). Girard, Kan.: J. A. Weisland. Pp. 20. 5 cents.

Reeves, Edward. Brown Men and Women, or the South Sea Islands in 1895 and 1896. New York: The Macmillan Company. Pp. 294. $3.50.

Reprints. Fernow, B. E.: Division of Forestry. Pp. 20.—Gifford, John. Forestry on the

Peninsula of Eastern Virginia. Pp. 4.—Kenyon, F. C.: The Terminology of the Neurocyte or Nerve Cell. Pp. 3.—Herter, C. A., M. D.: An Experimental Study of Fat Starvation, with Especial Reference to the Production of Serous Atrophy of Fat. Pp. 22, with plates.—Otis, D. H.: Root Tubercles and their Production by Inoculation. Pp. 16, with plate.—Rosse, Irving C., Washington: Brief Mention of Neurological Cases Successfully Treated. Pp. 8.—Stuve, E.: Do Vivisectionists inflict Unnecessary Suffering in their Investigations? Pp. 8.—Williamson, Mrs. M. B.: A Vanishing Island. Pp. 4.

Reye, Theodor. Lectures on the Geometry of Position. Translated and edited by Thomas F. Holgate. Part I. New York: The Macmillan Company. Pp. 248. $2.25.

Shaler, N. S. Outlines of the World's History. New York: D. Appleton and Company. Pp. 417. $1.75.

Smithsonian Institution: Publications available for Distribution. April, 1898. Pp. 39.

Story, A. T. The Story of Photography. New York: D. Appleton & Co. Pp. 169. 40 cents.

Treadwell, Augustus. The Storage Battery. New York: The Macmillan Company. Pp. 257. $1.75.

United States Geological Survey. Eighteenth Annual Report. Part V (continued). Mineral Resources of the United States. 2 vols. Pp. 1400.

University of Tennessee Record. No. 1: Review of 1897. Knoxville. Pp. 66.

Waring, George E., Jr. Street Cleaning in the City of New York, 1895, 1896, 1897. Pp. 234.

Wiley, John, & Sons. Announcements of Ladd's Manual of Quantitative Chemical Analysis, and Wells's Short Course in Inorganic Qualitative Analysis.

Fragments of Science.

An Episode in the Early History of Animated Photography.—The following interesting letter from Henry R. Heyl is published in the Journal of the Franklin Institute for April: "Among the earliest public exhibitions of photographs taken from living subjects in motion projected by the lantern upon a screen, was that given at an entertainment held in the Academy of Music, in Philadelphia, on the evening of February 5, 1870, and a repetition of this exhibition was made before the Franklin Institute at its next following monthly meeting, on March 16th, by the writer. The printed programme of this event contains the following allusion to this feature of the entertainment: 'THE PHASMATROPE. This is a recent scientific invention, designed to give various objects and figures upon the screen the most . . . life-like movements. The effects are similar to those produced in the familiar toy called the zoëtrope, where men are seen walking, running, and performing various feats in the most perfect imitation of real life. This instrument is destined to become a most invaluable auxiliary to the appliances for illustration, and we have the pleasure of having the first opportunity of presenting its merits to our audience.' The subjects exhibited embraced waltzing figures and acrobats, shown upon the screen in life size, while the photographic images were only three fourths of an inch in height. At that day flexible films were not known in photography, nor had the art of rapid-succession picture-making been developed; therefore, it was necessary to limit the views of subjects to those that could be taken by time exposures upon wet plates, which photos were afterward reproduced as positives on very thin glass plates, in order that they might be light in weight. The waltzing figures, taken in six positions, corresponding to the six steps to complete a turn, were duplicated as often as necessary to fill the eighteen picture spaces of the instrument which was used in connection with the lantern to project the images upon the screen. The piece of mechanism, then named the 'phasmatrope,' consisted of a skeleton wheel having nine radial divisions, into which could be inserted the picture-holders, each consisting of a card upon which was mounted two of the photo positives, in such relative position that, as the wheel was intermittently revolved, each picture would register exactly with the position just left by the preceding one. The intermittent movement of the wheel was controlled by a ratchet and pawl mechanism operated by a reciprocating bar moved up and down by the hand. It will be apparent that the figures could be moved in rapid succession or quite slowly, or the wheel could be stopped at any point to complete the evolution. In the exhibitions at the Academy of Music, above alluded to, the movement of the figures was made to correspond to the time of the waltz played by an orchestra, and when the acrobat performers were shown a more rapid motion

was given, and a full stop made when a somersault was completed. A shutter was then a necessary part of the apparatus to cut off the light rays during the time the pictures were changing places. This was accomplished by a vibrating shutter placed back of the picture wheel, that was operated by the same draw-bar that moved the wheel, only the shutter movement was so timed that it moved first and covered the picture before the latter moved, and completed the movement after the next picture was in place. This movement reduced to a great extent the flickering, and gave very natural and lifelike representation of the moving figures."

The American Professor.—Prof. Joseph Jastrow looks upon the American college professor as constituting a type of which it would be hard to find a counterpart anywhere else. His situation has recently been fully discussed in one of the magazines, and Professor Jastrow, commenting on the views there expressed, asks if the environment of our professor gives to his services a maximum of intellectual and moral value, and if it tends to develop most easily and successfully his own resources, and to urge him to the fulfillment of that function in the community for which his talents and training qualify him. The author can not answer these questions in the affirmative. There are undesirable factors in the professor's environment "which obstruct his public usefulness equally with his private happiness." He is "the type of the great underpaid, and this lack of income is, for many reasons, to be regarded as a calamity. . . . It is quite true that it were a pity that in the colleges of all places high thinking and plain living should be quite divorced; but it is a greater pity that the living should perforce be so arduous as severely to tax the energies that make for high thinking." From an investigation of the financial status of the professor, Professor Harper has found that he is on a par as to that with conductors, foremen of works, etc., with an average income of about sixteen hundred dollars, and that as a mere matter of justice his salary should be raised by one half—a conservative estimate. The average American professor suffers as much from the want of proper leisure as from the lack of a proper income, and the evil effects of the two are similar in kind; for the necessity of supplementing his inadequate salary will often direct his efforts into channels that promise some prompt remunerative rewards, rather than in the direction of the development of his maximum efficiency as a member of the university and as a personal influence. "Investigation and research, originality and scholarship come only as the slowly ripened fruits of leisure."

Montana Sapphires.—The existence of sapphires in Montana has been known for several years, but first attracted serious attention about 1891, when companies were formed and claims were taken up and examined with a view to mining for them. The sapphire region, according to Mr. George F. Kunz, extends for about six miles along the Missouri River, the central point being Spokane Bar, twelve miles east of Helena. Another region is between seventy-five and a hundred miles east of this, centering at Yogo Gulch. Mr. Kunz describes marked differences as existing between the sapphires from these two regions. All are of the same size, but they differ in crystallization, the Missouri River gems being prismatic, and those of Yogo Gulch largely rhombohedral. The value of these sapphires in jewelry can hardly yet be estimated. "Much beautiful material has already been obtained, but little of high value. Those from the Missouri bars had a wide range of color—light blue, blue-green, green, and pink—of great delicacy and brilliancy, but not the deep shades of blue and red that are in demand for jewelry. As semi-precious or 'fancy' stones they have value, however. The Yogo Gulch Judith River region is more promising, the colors varying from light blue to quite dark blue, including some of the 'cornflower' tint so much prized in the sapphires of Ceylon. Others incline to amethystine and ruby shades. Some of them are 'peacock-blue' and some dichroic, showing a deeper tint in one direction than in another; and some of the 'cornflower' gems are equal to any of the Ceylonese, which they strongly resemble."

The Filtration of Milk.—The wide area over which milk is collected for supplying a large city renders it practically impossible

to regulate the supply in a hygienic way by control of its sources. For this reason some general method of purification, which can be applied to the milk in bulk after it has been collected, becomes an essential to a safe product for general consumption. The ordinary tests, while fairly accurate in determining adulteration, are of no value in indicating the presence of disease germs or ordinary dirt. In fact, nearly any sample taken from the milk wagons of a city will be found to contain a number of bacilli which would immediately condemn any water as unfit for drinking. Sand filtration has been practiced for several years in some Continental cities, and apparently with very satisfactory results. The filters used by Messrs. Boll, large milk dealers of Berlin, consist of cylindrical vessels divided by horizontal perforated diaphragms into five superposed compartments, of which the middle three are filled with fine, clean sand, sifted into three sizes, the coarsest being put into the lowest and the finest into the uppermost of the three chambers. The milk enters the lowest compartment, and, having traversed the layers of sand from below upward, is carried by an overflow to a cooler fed with ice water, whence it passes into a cistern, from which it is drawn direct into the locked cans for distribution. The filtered milk is not only freed from dirt, but the number of bacteria is reduced to about one third, without sterilizing. The loss of fat is, in new milk, stated to be small, but the quantity of mucus and slimy matter retained in the sand—which is, of course, renewed every time—is surprising.

Spirit Drinking and Mental Depression.—Facts brought out by Mr. Bateman, of the British Board of Trade, in reference to the amount of drinking in different countries make the people of the United Kingdom more moderate in their drinking habits than has generally been supposed, and place them among the more temperate nations; for while in the consumption of beer, 30.7 gallons a head, they exceed the Germans as a whole with 25.5 gallons a head, the relatively small quantity of wine drunk, less than half a gallon per head, as against 29.50 gallons in France and the adjoining countries, more than restores the balance. And this result is not changed when the stronger drinks than wine are taken into consideration—1.94 gallons per head in Germany, 1.85 in France, and 1.01 in the United Kingdom. The Bavarians are the greatest beer drinkers, consuming an average of fifty gallons each in a year; next to them are the Belgians, with 43 gallons. The United States appears in the table as a vastly more temperate nation than any of these, its average rate of consumption of beer, wine, and spirits being less than half that of Great Britain. The London Spectator, taking Mr. Bateman's tables as its text, tries to find a mental rather than a physical cause for the appetite for drinking, and discovers it in the use of spirits as a means of obtaining relief from depression. In the United States, where the climate is exhilarating, life is easy, and the people are satisfied, drinking is decreasing; while "it is in France that drinking is now most prevalent, and is assuming the form least connected with the actual enjoyment of fermented liquor." Though wine is plenty and all are trained from childhood to drink it, the people "are taking to strong spirits of peculiarly nasty flavors," and some are spending nearly half their wages upon them. This, it thinks, is because "in France more than in any other country the people are becoming depressed and pessimistic, partly through the general loss of their faith, partly through a consciousness that they are not as great in the world as they think they ought to be, partly through the rise of the savage pecuniary discontents which produce what we are accustomed to call socialism."

Insects, and Books about them.—In a Brief Historical Survey of the Science of Entomology, by C. L. Marlatt, president of the Entomological Society of Washington, an estimate is made of the extent of entomological literature. Hajen's Bibliotheca, in 1862, listed 4,766 authors, 18,130 distinct titles, and 851 anonymous publications. The last volume of the Zoölogical Record, for 1895, gives 1,251 titles of publications on insects, which might perhaps be equivalent to seventy-five 500-page volumes; and Mr. Marlatt supposes, as a very conservative estimate, that what would amount to 2,000 such volumes have been published since the date of Hajen's work. In economic entomology, Henshaw's Bibliography of 1888 contains 5,424 titles and the names of more

than 500 writers; and about 700 entomological papers have appeared since then from the agricultural experiment stations. Hence, the author estimates the bulk of writings on insects available now at between 12,000 and 15,000 volumes; and this does not include the recent literature of apiculture. On a similar basis of calculation it is estimated that there are between twelve and fifteen hundred people now living whose works on insects are of such a character as to be noticed in the standard annual books of record. Besides these are the writers on bees, and the very large number of collectors of insects who rarely write on the subject. The number of species of described insects, excluding arachnids and myriapods, is estimated at 250,000; and it may be that, the world over, there are 10,000,000 species in all. Thus only one in forty of probably existing species is known—a fact that seems to throw grave doubt on much of our classification and characterization of genera. About 1,200 new genera and subgenera are added every year. "That the entomologists of the world have ample material with which to work, and that there is no alarming prospect in the immediate future of exhaustion of the field, is strikingly apparent." Dr. David Sharp has recently computed that in the matter of bulk insects probably outrank all other animals together, their small size being more than counterbalanced by the vast number of species and enormous multitude of individuals.

Economical Uses of Bacteria.—Prof. H. Marshall Ward, in his presidential address, which was read in his absence before the Botanical Section of the British Association, dwelt at considerable length on the many industrial processes which depend more or less for their success on bacterial fermentations. The subject is young, he says, but the little that has been discovered makes it imperative that we should go on, for the results are of immense importance to science, and open up vistas of practical application which are already taken advantage of in commerce. A bacillus has been discovered by Alvarez which converts a sterilized decoction of indigo plant into indigo sugar and indigo white, the latter then oxidizing to form the valuable blue dye, whereas the sterile decoction itself, even in the presence of oxygen, forms no indigo. Certain stages in the preparation of tobacco leaves and of tea depend on a carefully regulated fermentation, which must be stopped at the right moment, or the product is impaired or even ruined. While in flax and hemp the best fibers are separated by steeping in water till the middle lamella is destroyed, not every water is suitable for the process, but only that containing a particular bacillus, which destroys the pectin compounds of the lamella and leaves the cellulose. A process depending on this fact has been patented in the United States. The steeping of skins in water preparatory to tanning involves bacterial action for removal of the hair and epidermal coverings; and the swelling of the limed skins is a fermentation process. Hay and ensilage have to go through fermentations involving bacterial action. The various flavors of butter and cheese are each produced by special bacteria, and the cultivation of them has become a considerable business, so that the production of whatever flavor may be desired has become a matter of reasonable certainty.

Areca and its Properties.—The areca nut, a favorite stimulant of the many millions of people living in the East Indies and beyond, is the fruit of a tree, the *Areca catechu*, which, as described by M. Ernest Martin, following Chinese authors, has a trunk like that of the bamboo, straight and without branches, jointed in the upper part, with leaves like those of millet or sugar cane, under which are spathes containing fruits about as large as plums and protected by thorns. These nuts are edible. The bark of the tree is like that of the Paulownia; and it is on the whole very like the cocoa palm. It is regarded as one of the handsomest ornaments of the woods of the southern part of the extreme East. The nut is extensively used as a stimulant and as a remedy. It forms the basis of a preparation, with betel and lime, which is made to be chewed. After it has been used for a little while the teeth begin to assume a dark yellow or even blackish hue, from which the Chinese say that the Cochin-Chinese, Annamites, Cambodians, etc., tattoo their teeth. The effect sought in chewing areca is an excitation which, affecting the sali-

vary glands first, extends from them through the whole organism. When the indulgence passes beyond the bounds of "moderation," disorders set in, which first affect the teeth; and even young Annamites are not infrequently found toothless in consequence of excess. Medical properties are claimed for the areca by the Chinese doctors. It is said to help digestion, to drive away the deleterious miasms that ferment in the body, to be an efficient vermifuge, to prevent flatulence, to heal ulcers, and to be a prophylactic against malarial influences. The people of marshy regions use it instead of tea, on account of its properties as a febrifuge. When taken in strong doses, it produces intoxication. A Chinese poet, Sou Tong, who lived in the eleventh century, celebrates this property in his verses, but adds that when one is drunken with wine he has only to chew areca to be relieved of his heaviness and brightened up. The nut has the other properties of assuaging hunger, of being an excellent eupeptic, of drying up suppurations, for which the Annamite doctors use it powdered, and above all as a remedy for worms, particularly the tapeworms; and it has other uses in Indo-Chinese medicine.

Trees in Tennessee.—But few States in North America can show a greater variety of valuable timber trees than Tennessee. Almost every tree to be found in the United States grows in that Commonwealth. The fact is ascribed by Colonel J. W. Killibrew, in a paper he read before the American Forestry Association, partly to the great diversity of soils, partly to the great differences in elevation and consequently of climate, and partly to the abundant rainfall. Colonel Killibrew has collected a hundred and thirty kinds of wood, eight or ten of which are, however, exotics. Among the indigenous trees are four varieties of ash, three of birch, two of beech, two of magnolia, five of elm, two of fir, four of gum, eight of hickory, four of locust, three of mulberry, three of maple, four of poplar, six of pine, three of sycamore, fourteen of oak, three of willow, and two of walnut, besides many single valuable kinds, such as red cedar, chestnut, cypress, cottonwood, pecan, linden, spruce, dogwood, tiswood, etc. Nearly all the western counties of the State were originally covered with heavy forests, in which many species are nearly evenly distributed. The tulip tree, the white oak, red oak, hickory, gum, black walnut, wild cherry, basswood, ash, elm, and beech are interspersed with one another, while cypress abounds in the swamps. In Middle Tennessee, the supply of good timber is very scarce in the richer agricultural districts; but in a few counties in the southwestern part of this district is a large area of virgin forest. The most valuable timber trees in East Tennessee are the tulip, pine, chestnut, and white oak. The timbered tracts throughout the State consist largely of woodlands attached to farms. In some parts of East Tennessee there are, according to Mr. George H. Sudworth, dendrologist, hundreds and in other parts thousands of acres of standing white pine which would yield very large amounts of timber. The bulk of it lies in the northern half of East Tennessee, but it extends in a more or less scattered growth clear down to the southeastern corner of the State. Much of it is old, and in some localities it has ceased to grow. The bulk of this pine occurs alike in the narrow valleys and on the long, steep, sharp mountainlike ridges. The destruction of the forests is growing with alarming rapidity. The State, however, still has a large supply of timber; and in the future forestry of East Tennessee the regeneration of the white pine must be an important feature. Fortunately, the conditions are such as to make it comparatively easy.

North American Grasshoppers. — The common short-horned grasshoppers one sees every summer day—constituting a group which is described as forming the prevailing type of orthopteran life throughout North America—is the subject of an elaborate essay by S. H. Scudder which is printed in the papers of the United States National Museum (Revision of the Orthopteran Group *Melanopli* (*Acrididæ*)). These active insects, whose gymnastic feats cheer and enliven our summer walks through fragrant meadows, are of considerable economical importance, as may be realized when we recollect the destruction inflicted several years ago by the Rocky Mountain locusts, and the careful investigations and elaborate reports of which they were the subject. This voracious acrid-

ian, Mr. Scudder says, has numerous closely related allies in all parts of the United States, many of which often abound to such an extent as to do serious damage to crops, and a few of them have been known to migrate in a similar fashion to the Rocky Mountain species. The *Melanopli* are almost exclusively an American group. A single genus is represented in the Old World, north of 35° north latitude. With that exception, almost all the genera and species of grasshopper are in North America; although four genera, not described by Mr. Scudder, with twenty-four species, are found in South America. Eleven of the North American genera, with nineteen species, live exclusively in Central America and Mexico, passing the border of the United States only narrowly, and these countries also make two South American species at home. Six genera range over twenty degrees of latitude; two are known only in Florida. Most of the genera are Western; four are peculiar to the Mississippi Valley; three are found on opposite sides of the continent, and are therefore presumed to range over the whole of it; five are characteristic of the extreme West; and four are confined, or nearly so, to the region north of latitude 35°. For the purpose of his essay, Mr. Scudder examined nearly eight thousand specimens, of which about seven thousand belonged to the single genus *Melanoplus*.

The Invention of Printing.—From a recent number of The Chap Book we learn that the much-discussed question of who invented printing has been recently reopened by Gilliodts-van-severén, curator of the Archives of Bruges, who claims that a Jean Brito, of Bruges, printed from movable types before Gutenberg or Coster. The volume on which this claim is based, which is now in the Bibliothèque National at Paris, is an edition of the Doctrinal of Jean Gerson, the celebrated chancellor of the University of Paris, who died in 1429. There is no date on the volume, but on the last page are some Latin verses, the literal translation of which is something as follows: "Notice the beauty of this present writing; compare this work with other works; put this book by the side of another book; see with what neatness, with what care, with what elegance, this impression is made by Jean Brito, bourgeois of Bruges, who discovered without teaching from any one his marvelous art, and as well his astonishing implements, no less worthy of admiration." In 1773 the Abbé Ghesquière called attention to these verses, but the two schools of Mayence and Haarlem, which had narrowed the controversy down to Gutenberg and Coster, refused to admit a third competitor. M. Gilliodts-van-severén, who has reopened the controversy, has written a large volume on Brito. He has discovered many new documents in support of the latter's rights and much interesting matter concerning his life.

Women opposed to Woman Suffrage.—The energetic pressure of the agitation in favor of woman suffrage has met its natural reaction in the organization of women opposed to having the duty of voting thrust upon them. An association of this kind was formed in Massachusetts about fifteen years ago and had the satisfaction of seeing a woman-suffrage measure defeated by popular vote in 1895. The New York State Association opposed to the Extension of Suffrage to Women was formed in April, 1896, and now has a standing committee of more than one hundred women, twenty thousand members, and branches in some of the large cities. The Illinois association, formed in May, 1897, has issued a circular defining the position and motives of the women who have taken this stand, and answering some of the arguments that have been put forward in favor of woman suffrage. Exclusion from the franchise, the circular says, does not imply inferiority, but division of qualities. "A little reflection shows that the kind of intelligence which the lawmaker should possess, the knowledge of the practical things of the outside world, such as currency, banking, the franchises granted to corporations, the general control of vast commercial and manufacturing interests, with other details of practical life, not easily enumerated, are affairs which lie almost wholly within the domain of man, and which it would be a sad waste of energy for women in general to become familiarly acquainted with. . . . Does it therefore follow that women are on the whole inferior to men? By no means. In her own domain, which includes the most

vital, the most spiritual, the most progressive elements of life, woman is as much man's superior as he is hers in outer and material things." Everywhere, the circular continues, intelligent women of good character are effective agents in good work, public as well as private. It is only the women who are without moral influence who lack this power; and to give them the ballot would not only be a mistake in itself, it would place in their hands the power utterly to nullify the moral influence of the more enlightened of their sex. The pure and educated women of the nation, non-voting, and thus unbiased by the selfish considerations which naturally sway political aspirants, should form the strongest and purest element of conservatism possible." The noblest and most useful work of woman has ever been and ever will be "in that domain in which man can never take her place, or become her peer or rival. . . . We believe that men do look to women, and it is our desire and prayer that they may never look in vain, for the maintenance of the home, the upholding of lofty, pure ideals of domestic and social life, the moral education and training of children. . . . It is the compensation which woman owes to the state for the protection which she enjoys in the home, and for immunity from public labor and service, that she should rear her children with right habits and instill into their minds true principles and noble ideals of life, and she can not do this while she is managing political machines and besieging legislatures."

MINOR PARAGRAPHS.

In a paper on oil-producing seeds, in the Yearbook of the Department of Agriculture, Mr. Gilbert H. Hicks estimates, supposing that two pounds of seed are produced for every pound of ginned cotton, nearly 4,000,000 tons of cotton seed were produced in the United States in 1894–'95. Deducting about one third of this, required for sowing, there would remain more than 2,500,000 tons of seed. Of this amount, about 1,500,000 tons were worked at the oil mills, each ton producing 45 gallons of crude cotton-seed oil and 800 pounds of cotton-seed cake. This estimate gives a total of 60,000,000 gallons of oil and 600,000 tons of oil cake produced in the United States in a single year. At 30 cents a gallon, this crude oil was worth $18,000,000, while the oil cake exceeds $12,000,000 in value. Of this annual production of oil, about 9,000,000 gallons are used in making "compound lard," etc., while the rest is exported or is mixed with drying oils or used in the manufacture of soap. Cotton-seed oil is also largely used for adulterating other oils.

A URANOMETRY of the bright southern stars has been completed at the Arequipa station of Harvard College Observatory, each star having been compared by Argelander's method with adjacent stars slightly brighter and fainter than itself. Visual observations of the southern variables have been obtained every month as far as possible. Counts have been made of the number and distribution of stars in several clusters. The meteorological stations have been maintained at Mejia (elevation, 100 feet), La Joya (4,150), Arequipa (8,060), Alto de los Huercos (13,300), Mont Blanc station on El Misti (15,600), El Misti (19,200), and Cuzco (1,100). Interference with the carefully formed plans of the Astrophotographic Congress being undesirable and duplication of work unadvisable, the plan of preparing and publishing a complete map of the sky by the aid of the Bruce telescope has been abandoned, in the belief that more useful work can be done with the instrument in other ways. Glass copies of negatives, of any part of the sky, will be furnished to astronomers who desire to study them. It is believed that most valuable work can be done by careful study of particular regions by means of such photographs. The library of the observatory contained, October 1, 1897, 8,635 volumes and 12,992 pamphlets. Special efforts are made to render the collections of meteorological as well as of astronomical publications as complete as possible.

THE great power of adaptation of the lower and smaller animals has received the special attention of Prof. L. C. Miall, who remarks upon the readiness with which they assume new stages or drop old ones, and the bewildering variety of visible contrivances and changes of forms which they take on.

Worms that can hardly be classified, and larvæ which give no clew to their parentage, exhibit beyond other animals the tendency to multiply rapidly, and to break away from one another at an early stage—a tendency which is so strong in the microscopic protozoa as to enter into the definition of the group. Fission, budding, alternation of generations, and spore formation are ultimately due to the same tendency. Weak animals make up, by their invisibility and their ability to scatter and evade, for the lack of powers to resist. If one polyp of a hydrozoa colony is bitten off, others remain, so that no enemy can possibly devour all the medusæ liberated from one colony or all the planulæ liberated from one medusa. Some animals and plants multiply by being torn to pieces or chopped small. Small animals are usually short-lived; and those that last as long as a year are often driven, like annual plants, to adapt every detail of their existence to the changing seasons. The naturalist who explores the surface waters of the sea soon learns that the time of year determines the presence or absence of particular larvæ.

THE importance and great expense of securing a pure water supply in large cities, and the carelessness with which the average householder handles his taps, have led many municipalities to consider the use of water meters. Such an attempt is now being made in Philadelphia, and is, it is stated, causing some dissatisfaction. There is no question that the water meter is a thing of the near future. The great care and expensive mechanism which are now coming to be considered necessary in securing a safe city water supply have added so much to its cost that wanton waste of it can not be tolerated; and, besides this, the small individual savings at each house, when added together in a large city, will go far toward furnishing a supply for various public sanitary purposes, such as daily flushing of the pavements, etc., and in this way also tend to improve the hygiene of the town.

THE halibut fishery on the northwest coast of the United States has developed into an industry of considerable importance, and there are now, Mr. A. R. Alexander says, in a Bulletin of the Fish Commission, nearly double the number of vessels engaged in it that there were four years ago. The demand for this fish five years ago was mostly limited to local orders; now large shipments are made to all parts of the West, and important consignments have been sent to the Atlantic coast by Canadian fishermen. The American catch finds a market in the States west of the Mississippi River. When this fishery began on the Pacific coast Port Townsend was its center, but for the last few years Tacoma and Seattle have absorbed the business. Halibut on the northern coast banks are very erratic. In places where they are numerous one day, few will be found the next. It frequently happens that a vessel will have good success for several days, and in a few hours' time fish will become so scarce that it is useless to remain longer on the ground. Fishermen can give no cause for this sudden disappearance other than that the halibut are traveling in schools, going from one bank to another, and not stopping long at any one place. Halibut do not seem to be very particular as to their food.

IT is stated in Industry and Iron that, after a series of tests which have proved satisfactory in every respect, the Prussian Railway Department has decided to introduce a mixture of acetylene and oil gas for train lighting on the state railways. It is said that by the admixture of one part of acetylene to three parts of oil gas the illuminating power of the latter is increased three hundred per cent. A flame consuming twenty-seven litres of the mixture per hour produces sixteen-candle power. The use of this mixture offers the great advantage that neither in manufacturing methods nor in the present oil-gas appliances in the carriages is any change necessary. As a pattern for the installation of the other gas plants to be erected on all the railway lines of the kingdom, the minister recommends the acetylene gas plant at Grünewald station, near Berlin. The present annual consumption of Pintsch oil gas on the Prussian railways is one hundred and twenty-seven million cubic feet.

THE curious formations known as bezoars, of common occurrence in the stomach and intestines of ruminants, are simply masses of indigestible material which, either owing to excessive size or other cause, are not

thrown off. They were formerly of great repute as alexipharmics (medicines supposed to neutralize infectious or other poisons). Two curious specimens of this formation—which is, when of vegetable origin, known as a phyto-bezoar—are described in a recent number of the Pharmaceutical Review. They were taken, along with fourteen others, from the stomach of a bull at the Hacienda de Cruzes in Mexico, were of a brown color, somewhat resembled felt or rubbed sole leather in appearance, and consisted of the barbed hairs of the *pulvini* of the platopuntias. To the barbs with which the hairs are covered is due their power of felting together. Concretions akin to bezoars are sometimes found in the human stomach.

NOTES.

THE exploring yacht of Prince Albert I of Monaco, the Princess Alice, made its fourth cruise of scientific research in the summer of 1897 in the waters west of Morocco, around Madeira, and the regions of the Azores and the sea off Portugal. Weirs sent down to depths of nearly sixteen thousand feet brought up animals wholly unknown. Another net kept for twenty-four hours at a depth of about thirty-seven hundred feet, near the Azores, brought up twelve hundred animals, of which eleven hundred and ninety-eight were fish. Large cetaceans were often chased by the whale boats; and in some instances unknown animals, from forty-five to sixty-six feet long, yielded remnants of food which they had swallowed—fragments of gigantic devil fishes, which were carefully preserved.

THE spore dust that is often seen on cereals promises to be available as a pigment. David Pearson reports, in Nature, that a rich amber color, sometimes approaching sepia in tone, is obtained from smutty oats, and that when applied as a water color it remains fast and unaltered in ordinary diffused daylight, and changes but little in direct sunlight after months of exposure.

EXPERIMENTS have been made by M. Perchor, of the French Academy of Sciences, from which he is satisfied that the zenith point can be determined directly with astronomical instruments as accurately as the nadir is found by means of the mercurial bath.

THE investigations respecting the culture of the sugar beet made, by the Ohio experiment station, indicate that some parts of the State offer considerable encouragement to the industry. In three respects of temperature, soil, and rainfall they seem to offer all that is necessary for the best production. There still remains, however, much to be done before it can be positively asserted that beet sugar may be profitably produced in Ohio.

TOWARD the end of the year 1896 Mr. Spencer consented, at the request of a large number of distinguished men, to have his portrait painted by Mr. Herkomer. The portrait is now finished, and will be sent to the next exhibition of the Royal Academy. It is said to be the intention to finally offer the picture to the trustees of the National Portrait Gallery.

AT a meeting of the New York Academy of Medicine, on February 17th, the following resolution was unanimously adopted: "*Resolved*, That the fellows of the New York Academy of Medicine do earnestly recommend the establishment of a bureau of health, with the power to administer, within constitutional limits, the sanitary needs of the United States."

THE net earnings of the railways of the United States for the year ending June 30, 1897 (that is, the amount of gross earnings remaining after the deduction of the operating expenses of the railways), representing an operated mileage of 180,027.65 miles, were $369,050,856.

IN the later death lists we find the names, among men associated with science and the arts, of Dr. Hermann Kämmerer, professor of chemistry at Nuremberg, April 12th, aged fifty-eight years; Dr. Samuel Gordon, president of the Royal Zoölogical Society of Dublin; M. Demontzey, correspondent of the French Academy of Sciences in the Section of Rural Economy; Dr. Hermann Schapira, professor of mathematics at the University of Heidelberg, May 9th, aged fifty-seven years; Maurice Hovelacque, secretary of the Geological Society of Paris; W. C. Lucy, an English naturalist of great activity and local fame, contributor of numerous papers to the proceedings of the Cotteswold Naturalists' Field Club, an observer whose name is familiar to readers of Nature; Dr. C. Herbert Hurst, formerly of the zoölogical department of Owens College, and later of the Royal College of Science, Dublin, author of many papers criticising modern biological theory; M. C. J. Souillart, professor of astronomy in the University of Lille, and author of several important papers on mathematical astronomy; D. S. Kellicott, professor of zoölogy at Ohio State University; Paul Henri Schneider, chief proprietor and director of the great iron works at Creusot, France, aged fifty-eight years; and Lord Lyon Playfair, at one time professor of chemistry in the University of Edinburgh, but who spent most of his active life in public or official positions in which the scientific function was highest in importance.